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THE REGULATION OF RAILWAYS' ACT, 1889.

THIS Act, amongst other provisions—in themselves, as compared with that which we are about to quote, of a very minor character—enacts:—That "the Board of Trade may from time to time order a railway company to do, within a time limited by the order, and subject to any exceptions or modifications allowed by the order, any of the following things." Then follow the things to be adopted, to wit:—The adoption of the block system on all or any of their railways for public conveyance of passengers. The interlocking of points and signals. Continuous brakes, complying with the requirements of the Board of Trade, viz: instantaneous action by engine driver and guards; automatic action in event of any failure in "the continuity of its action;" applicability to every vehicle of the train, whether carrying passengers or not; the brake to be in regular use in daily working, and the materials of which it is composed to be of a durable character, and easily maintained and kept in order. Power is granted to the Board to enforce, through the Railway and Canal Commission, obedience to such orders as may in relation hereto be issued; and, perhaps what is still more necessary, power is reposed in the Board to authorise the creation of such portion of the expenditure as may be needed for carrying out such improvements as is properly applicable to capital account, by the issue of debentures or debenture stock "in priority to or ranking *pari passu* with any existing debentures or debenture stock of such company, bearing interest at a rate not exceeding 5 per cent. per annnm."

Probably the first question which will be asked in relation to such a sweeping measure as this, is, when will it be carried out? We believe there is no intention on the part of the Board to allow the Act to become a dead letter. It has been framed by the Board with the object of strictly enforcing it, and we think it quite possible that it will be found that the order for the establishment of the block on such sections of line as are not so provided will be issued at once, a twelvemonth only being allowed for its enforcement; and that a similar order will follow, if not accompany this order, for the interlocking, two years, or thereabouts, being allowed for its establishment.

The Act may be regarded as an implement for forcing those railways which have for so many years been indifferent to the requirements of their traffic to provide what is considered needful for its protection. The chief companies in England—the North Western, Great Western, Midland, and Great Northern—will, probably, find little trouble in readily complying with its demands; but to the smaller lines, the Scotch and Irish railways, the demand will not be an agreeable one. With many it is even possible that even with the exercise of the monetary powers contained within the Act, the power to raise debentures to the amount required will fail to produce the required result. If we turn to the Board of Trade returns for the past year, we shall see how great is the work to be dealt with. Looking first to the block, we find as regards England and Wales, we have 8,572 miles out of 8,801 of double line, and 3,583 out of 4,548 miles of single line provided for; that, with regard to Scotland, the proportion stands 1,184 out of 1,192 double line, 1,120 out of 1,627; whilst in Ireland the figures are, double line 184 out of 592 miles, and for single lines 380 out of 2,124 miles. There thus remains, so far as the block is concerned, no less than 3,861 miles yet to protect. With regard to interlocking we find only 3,861 cases yet to be dealt with.

Although interlocking will doubtless, to some extent, affect the electrical branch of the railways concerned, it is to the establishment of the block to which the attention of that branch will be chiefly directed. Where railways have not yet determined upon, or already adopted a system of block, the present is an opportunity which should not be lost sight of for ascertaining and securing that which is the most perfect and the most reliable. Those lines which have become wedded to a system will, we may assume, continue to use it. Where, however, there appears to be room to doubt the value of an adopted form, there should be no hesitation in replacing it. In seeking to determine the question as to which is the most fit, it should be borne in mind that first cost is not the most important consideration. The cost of maintenance, the reliability, freedom from failure, &c., are all points of the greatest importance. Failures, where a block system is strictly worked, entails stoppage—or slackening—of traffic. To a busy line this means far more money than appears on the face of it. As a rule, three-wire systems are far more reliable than single-wire systems. The "All clear" signal under such systems is maintained by gravity or by a permanent current. There is little, if any, possibility of a foreign current reversing the position of a signal so worked.

Another point for consideration is the propriety of affording a means of communication between signal box and signal box. On some lines—notably, we think, on the Great Western—this is provided by arranging a local single needle circuit between each signal post, so that the signalmen may make any enquiry they desire of one another anent the traffic. On the Midland, we understand this is also being gradually effected at busy centres by means of telephone circuits, and at other less busy points by means of a patented arrangement combining block—bell and telephone—using the same wire for both bell and telephone. On more than one occasion the provision of some such communication has been recommended by the Board of Trade inspecting officers. The present affords an opportunity which will probably never recur for considering the propriety of employing such apparently useful adjuncts.

It is somewhat surprising that when seeking such exceptional powers, the Board of Trade did not go a little further and secure—at all events, for important and busy points—the interlocking of the electrical with the mechanical signals. It is quite true that the introduction of the automatic brake places in the hands of careful drivers a ready means for stopping their trains, but this does not obviate mistakes on the part of signalmen. The mechanical signals govern the trains, and the electrical signals are provided for the purpose of governing the mechanical signals—that is, the signalmen are required to work their signals by the indications of the electrical apparatus. How much safer it would be were the one interlocked with the other, so that the "line clear" signal could not be conveyed to the driver of a train unless the block post for the section ahead so communicated it by his electrical instruments, needs, we think, no demonstration at our hands.

The occasion is one on which no doubt the views of many of our railway electrical engineers will be called into requisition, and we feel satisfied the importance of the question will commend itself to their careful consideration.

* * *

THE panic that has arisen in New York in consequence of the rapidly increasing death-rate from electric currents of high potential has given a further opportunity to the champions of low tension to enforce their views. Finding that the Mayor and Board of Electrical Control were hampered by legal injunctions from acting with full vigour against the offending wires belonging to what are now called Wild Cat Companies, and believing the Board of Health to be the only department of the city authorities beyond the reach of injunctions, and that the Board of Health, on a proper complaint being made to it by three citizens, would be compelled to act, Mr. H. P. Brown, in conjunction with two other citizens, lodged a formal complaint with the bureau, calling attention to the power it possessed, under a section of the Consolidated Act, of removing "any obstruction, matter, or thing in or upon the public streets, side walks, or places which shall be liable to lead to results dangerous to life or health, and the prevention of accidents by which life or health may be endangered."

* * *

THE Department considered the matter, and at length came to the conclusion that prior to and as a basis for further action a tour of inspection should be made to the several electric light stations, and the condition of their plant examined. The Brush Company and the United States Company having shut down, the officers of the Board drove to the station of the Manhattan Electric Light Company as the next most important installation. The party inspected the dynamo room, in which were ten Fort Wayne Jenney alternating dynamos of the Manhattan Company, three continuous incandescent current machines, three Thomson-Houston pulsating arc current dynamos, and one pulsating arc current Brush dynamo. The three latter systems were supposed to work at 990, 2,200, and 1,980 volts respectively. Mr. Brown was ordered by the President of the Board of Health to measure the leakage from the various circuits. The voltmeter used was one supplied by Mr. Brown reading to 3,600 volts. After the tests the voltmeter was handed to Dr. Edson with instructions to have the instrument re-calibrated to compare with the actual readings. The first circuit tested was a continuous current one, and showed a leakage difference of potential of 915 volts; the second continuous circuit was in good condition, while the third continuous current circuit gave 1,000 volts. There was little leakage on the Brush circuit, and not more than 30 volts on the Thomson-Houston system. The high tension alternators, however, showed a potential difference varying from 150 to 600 volts, only one circuit going below 300 volts leakage. Although the United States Company lines could not be tested, their unsafe condition may be surmised from the fact that they deem it necessary to discard all their existing wires, and substitute new and better insulated cables at an enormous expense for labour and material, and this, too, in the face of the probability that, in a short while, they will be compelled to bury all the wires underground at a great additional cost.

* * *

IT is only fair to the lighting companies to mention, that in whatever degree they may be willing to carry out the orders of the mayors as to the placing their cables in underground conduits, it is utterly impossible for them to comply with the order. It is far from likely that, at the rate these conduits are being constructed at present, the companies will be able to bury the whole of their wires under a lapse of, perhaps, three years; unless, indeed, the Mayor gains his point with the Board of Electrical Control, and many different subway contractors, or companies, are allowed to proceed with the work at the same time. The old company thinks it has the monopoly, and does not hurry matters much. If the subway system is to be carried out in earnest there are, at least, 25 miles to be made, and the old company admits that it cannot complete that mileage under three years; so, for the public benefit, we trust Mayor Grant may have his way. The insulation on the present overhead wires must be of the poorest description; one kind of wire, with white covering, being avoided by all linemen as though it were a venomous reptile; while all descriptions have the insulation stript off near the posts from the abrasion caused by the boots of the workmen who have to ascend the poles for making repairs. Let the companies in this country, who are about to supply the electric light, take heed from the disasters that have occurred in the United States.

THE first annual banquet of the Institution of Electrical Engineers was a complete success, and reflected great credit on those who had the arrangements in hand. We believe the worthy secretary, Mr. F. H. Webb, did the lion's share of the work, and to him especially we tender our heartiest congratulations. From the beginning to the end all went merrily, and doubtless the annual dinner will in future form an important feature in the proceedings of the Institution.

IN a leaderette in our last week's issue referring to gas explosions in conduits we remarked:—"It is not too much to say that the advent of gas into our street electric conduits is extremely probable, if not absolutely certain; have our electric light companies thought of it?" Not having had any practical experience in such matters it was hardly expected that any of the electric light companies would have thought of such a thing, but we venture to assert now that at least one of the companies has thought seriously over the matter since our remarks were written, for, from what has come to our knowledge, the company in question has obtained some really useful practical experience on the best method of facilitating subway explosions.

THE accompanying extract from an evening contemporary, headed by sensational wording, reads almost as if it were chronicling one of the by no means uncommon New York occurrences. "This afternoon (Friday, November 1st), at 2.30, a terrific explosion occurred at Albert Gate. It appears that the electric light was being laid on to a new building now nearing completion, when one of the batteries (*sic*) laid underneath the flag stones burst with a loud report, tearing up the pavement for some distance around, and sending the iron plates high in the air. Fortunately, beyond the falling *débris* striking a cab horse no other damage was done, notwithstanding the fact that it happened at the busy part of Knightsbridge, where the 'buses usually set down and take up." This is headed as an "Extraordinary occurrence at Knightsbridge, the pavement blown up."

JUDGING, however, from our remarks, the occurrence cannot be considered as "extraordinary," for it was distinctly foreshadowed as being "absolutely certain" to occur, but we must admit that we did not exactly expect to have the strong warning we gave so emphatically emphasised in a few hours by an actual example of the very danger practical experience led us to expect sooner or later. It has come sooner, but it is not yet too late for those companies who have put down conduits, and who are still doing so, to at once consider the best precautionary device to obviate further disasters. We have already pointed out as simple and effectual a method as can be well conceived. This question of proper ventilating the electric light conduits is one which should claim the attention of the surveyor of the district at once, and so prevent the recurrence of similar explosions.

IT is well known that the ignition of the explosive mixture in a petroleum engine, say, that of Priestman, is effected by a spark from an induction coil. The two metallic points, between which the spark plays, are, of course, well insulated from one another by means of the porcelain cylinder, through which they pass. An amusing incident has recently occurred in connection with the working of one of these valuable motors, which is too good to be buried in oblivion. During an examination of the contacts, when cleaning the engine, the man in charge noticed that a portion of the porcelain cylinder had become chipped and broken away, and thinking, therefore, that their condition was somewhat insecure, he took upon himself to enclose them in something less liable to fracture. He set to work and made two brass ferrules, and in these he secured the contact points, and then, having got everything else in ship-shape order, he attempted to start his engine. Do what he would the motor was no longer the thing of yore, and in the end it became necessary to send for assistance to a well-known electrical firm, whose *employé* soon discovered the secret of the downright refusal of the gas to explode. A friend of ours has suggested that the engineer had become a convert to Mr. Varley's method of reasoning to show that a good conductor is a perfect insulator, but we give this only as hearsay evidence.

THE remarks of the Marquis of Salisbury at the dinner of the Institution of Electrical Engineers should give encouragement to the electrical trades, for his utterances are not those of an enthusiast or dreamer. It is well known that his lordship is well informed on all matters electrical, and that on his Hatfield estate much experimenting has been carried out, both in electric lighting and the transmission of power. His oration may then be taken as the view of a serious thinker who can clearly perceive immense developments of electricity in the near future, although we somewhat fear that the happy time when the various members of a family of workers can pursue their labours at home through the universal employment of electro-motors is not likely to occur during the present generation. Nevertheless, the speech of the noble Marquis is entitled to every respect, and it must be very gratifying to the members of the Institution to know that the all-powerful influence of electricity has such an advocate to preach it to the world.

CONTINENTAL NOTES.

[FROM A CORRESPONDENT.]

ALTHOUGH not exactly a continental item, it may be interesting to know that a syndicate of American, English and Chinese capitalists has been formed to work the Brush system in China, the light being already installed at Shanghai.

Apropos of China, it may be of interest to state that a telegraph line is now being laid between Pekin and Kjachta, on the Siberian frontier, whereby the cost of telegrams to that country, *viâ* Russia, will be considerably cheapened.

The ladies of the Russian telegraph service are raising a great outcry in the Press against the hardship of the law in force in Russia since 1864 that they may only marry telegraphists, and that, too, only those who are engaged at the same station, the official idea being that they thereby, in case of need, would be able to take the place of their husbands. A young Russian lady writes pathetically to the *Nov. Wremja:* "I have, therefore, if I do not choose to forfeit my situation, first to fall in love with an electrical swain, then to manage that *he* falls in love with *me;* next to arrange that he is transferred to *my* station. This is a hard task for a poor girl who is rivetted 14 hours every day to her apparatus, and does not wish to lose her pittance of 720 roubles a year?" Truly, these nineteenth century vestals, as that journal calls these ladies, have cause for grievance.

We referred on a recent occasion to the so-called Northern Telegraphic Agency in St. Petersburg, and the dissatisfaction expressed over its working, and it now appears that the Russian Government has decided from the beginning of next year to deprive the agency of all its privileges, whereby its career is, no doubt, at an end. It is maintained that the agency is in the pay of the great Continental telegraph agencies controlled by Jewish capitalists, and that this is a degradation to Russia. As an example, it may be mentioned that its news is generally two or three days old before communicated to the Press, and that even sometimes its telegrams are circulated after the news has been brought by post. It is the intention of the Government from the beginning of next year to establish a new thorough Russian telegraphic agency under the administration of the notorious Prince Meschtscherkeski, editor and proprietor of the well-known journal *Grasjdanin*, the most orthodox organ in Russia. However, as the rest of the St. Petersburg Press dislikes the Prince and his views, it is probable that they will not support this agency; but all the provincial journals, which are under official censure, will be compelled to subscribe to it.

The electric light has found a curious use in Russia—orthodox Russia, of all countries—viz., for illuminating saintly images in cathedrals. Thus a magnificent figure of the Madonna, just placed in the Alexander Newsky Monastery, loaded with precious metals and gems of immense value, stands glitteringly in the focus of an electric beam, which is also the case with the "Kasan" Madonna in St. Petersburg. From near and afar thousands make pilgrimages to these shrines.

Apropos of using the light for ecclesiastical purposes, it has been decided to light the ancient monastery of St. Ursula at Olmütz with it, the first instance on record of its being used in a monastery.

In Berlin the four "greatest dynamos in the world" are now being constructed at Messrs. Siemens and Halske's works at Charlottenburg, which are intended for the two new great central stations in Berlin. Each station is to have two of them. They are of 1,000 H.P. each, and are capable of feeding 10,000 glow lamps. It is claimed that such powerful dynamos have not even been manufactured in America. The machines are composed of a fixed cruciform electro-magnet, around which rotates a ring-shaped armature, over three metres in diameter.

It is noted in Berlin that Mr. Weems, director of the Electro Automatic Transit Company of Baltimore, has reproduced Dr. Werner Siemens's idea of long ago of an electric letter post. Dr. Siemens proposed that this form of transit of letters should replace the pneumatic tube system now in use in Berlin and Paris, the letters being conveyed on small electrical cars through a tube at a very great rate of speed. Mr. Weems claims that his cars can run 4,800 metres a minute—*i.e.*, covering the distance from New York to San Francisco in 24 hours.

A curious accident befell a picket of Uhlans the other day in the Berlin Thiergarten through being struck by lightning. The flash recoiled from a tree, and, striking the picket, sent men and horses in an instant sprawling on the ground. Of five men and horses one man and a horse were killed outright, and one man paralysed.

The question of regulating the public clocks in Berlin by means of electricity is greatly advocated by business men. Hitherto only 41 clocks have been thus regulated, but now 17 more are to be fixed, and these will be controlled by the Berlin Observatory. However, the novelty in the system to be tried is that the clocks will be regulated through the telephone wires. The clocks are pneumatic ones, but the pneumatic apparatus working them is set in motion by an electric current transmitted through telephone wires. This is said to be a far less costly system than that used in other great cities for this purpose. In Paris, for instance, there have been since 1878 several thousands of clocks regulated by electricity, but it is said that the system is too dear, and is not applicable everywhere.

The death recently of the French author, Villiers d'Isle Adam recalls the fact that he based a novel, "l'Eve Future," upon Edison's inventions. However, his prediction does not correspond with present reality, as Adam causes Edison to produce an electrical woman of surpassing beauty, who imitates in a deceptive manner the appearance, speech, and movements of Eve of the present day.

At the last meeting of the Paris Academy of Sciences, M. Mascart presented a note by M. Moreau on the disturbances which were noted among the magnetic apparatus at the Parc St. Maur on October 20th, at the same time as an earthquake was felt in the Dardanelles.

A central electrical station, capable of feeding 100,000 lamps, and to start with 20,000 only, by means of alternating currents, has been installed on the Danube near Vienna for the lighting of that city.

The Municipality of Copenhagen is about to instal one or two central stations for electric lighting, in order to supply light to private houses, and afterwards to the public thoroughfares.

The results of the electric lighting undertaken at Stockholm by the gas company of that city have been most satisfactory. The electric lights already numbered, at the end of 1888, more than 14,372 incandescent lamps, and 247 arc lamps. The town of Holmstadt has just adopted the electric light, and is asking for the installation of a central station, capable of feeding 1,000 incandescent lamps and 80 arc lamps.

It is announced that trials of the application of electricity to navigation are about to be made in the harbours of Cadiz, Corunna, &c., by means of accumulators, by a company in the course of formation. The electric light which is working at Madrid is, it is stated, established under very defective conditions, especially in the theatres. At the Comedia Theatre, on the second day of opening, there was a total extinction, and the play had to be finished by the aid of candles hastily lighted. It is understood that the municipal administration, which is making at the present moment praiseworthy efforts to ensure an improved light, is about to require of the electric lighting companies the employment of electric accumulators.

The electric lighting of railway carriages by the Western Swedish Company, which has been working satisfactorily for a year, is about to be adopted by the other railway companies in Sweden. It is now installed in all the trains from Helsingborg to Gothenburg, and from that place to Christiania. In Finland the electric light has been fitted in the sleeping cars running between Helsingfors and St. Petersburg; and on the Danish lines from Copenhagen to Korsod the same system of lighting is about to be adopted.

Although not strictly a Continental Note, we may mention that the King of Siam has subscribed for 2,875 shares out of the 6,900 of the electric light company in course of formation in Bangkok.

The following particulars have been published on the electric lighting of Saint Quentin (France):—The municipality of St. Quentin have regulated the lighting of the town by gas by imposing certain conditions on the St. Quentin Gas Company. The company is required, among other things, to distribute the electric light in a given perimeter, in the public streets as well as to private consumers who ask for it, and under the conditions determined by the agreement, of which the following are the principal clauses:—The canalisation will be aerial, but the company will be able, in case of need, to place cables in trenches or in the sewers. The gas company may extend the electrical conductors outside the aforesaid line; it will be forced to do so when it is guaranteed a consumption of 750 watts for an annual duration of 750 hours, and per decameter of canalisation; this consumption being calculated according to the mean of a determined line. In every case the company will not be expected to prolong its lines beyond a distance of 900 metres, reckoning from the Place de l'Hôtel de Ville. The company will supply the electric current in all the streets in which it may have conductors to every consumer who shall pay a subscription of three months at least, and will guarantee an annual average consumption of 300 ampère-hours per lamp of 10 candles, or in the same proportions. The electric current will be supplied by meter, consequently the subscriber will be able to instal in his house, and at his own expense, one or several meters, according to his choice, taken from among the systems chosen by the company and the municipal administration; or else the meters will be proportioned to the consumption of electricity of the consumer. They will be subject, as to their exactness and the regularity of their working, to all the verification which the company or the subscriber may think necessary. The company will be held to furnish the meters on hire; the monthly hire being payable at the same time as the cost of the electric current. The following is the cost per month for line and maintenance of the meters:—

			Francs.
Meters of	5	ampères	2.50
„	10	„	4.00
„	20	„	5.00
„	40	„	6.00
„	100	„	10.00

In consideration of this payment the company will have to lay down, maintain, and keep the apparatus in repair. The subscriber will have the free disposition of the electric current which shall have passed the meter. The price of the electric current for lighting will be at a maximum of 16 centimes (1¾d.) per 100 watt hours. The installation of the lighting material will be made at the expense of the consumers by the company from the principal canalisation to the meter; the company reserves to itself the right of control over all the remainder of the installation, which must be arranged so as not to impede or obstruct in any way the service generally, and to work under the existing potential in the electric network. The authorities of the town reserve to themselves the right to instal in the thoroughfares, where there is an electric canalisation, arc lamps, or those of any other system; these lamps will be placed at their expense, and kept in repair by the company. This apparatus will be subject, as far as regards its method of working, to the same conditions as private installations. The price of this lighting is fixed at 1 f. 20 c. per kilowatt. The electric current for lighting will be supplied from the fall of day to 12.30. The authorities of St. Quentin reserve the right to lower the maximum prices fixed, as above, for the town and private customers every five years from the approval of the present agreement by the prefectoral administration, in accordance with the prices in force in Paris at the various periods; but it must be well understood that a lowering of price will only take place when it is established that the electricity companies distribute to their shareholders on an average 10 per cent. of the capital engaged, interest included, and redemption calculated at a period of ten years. The gas company engages itself to lodge with the authorities a rent of 11 per cent. on the net products of the sale of electric energy, under the same conditions as those indicated by the sale of gas. The company will pay besides, to the authorities, an annual sum of 100 f. per kilometre of canalisation, both aerial and underground. The town of St. Quentin concedes to the gas company the exclusive right of laying and keeping in repair on, or under, the public thoroughfares, conductors destined for the transmission of electric energy, either for lighting, motive power, and all other applications of electricity. The paving works to be executed over the trenches will be done by the authorities on the company's account, against a payment of 2 f. per linear metre for private branches, and 1 f. 50 c. the square metre for conduits running along the public thoroughfares. The authorities formally engage, during the whole duration of the new agreement, to oppose, by every means in their power, the granting of authority to place canalisations for gas and electricity.

NOTES FROM DENMARK AND NORWAY.

[FROM A CORRESPONDENT.]

THE question of a central electrical station for Copenhagen, worked and maintained by the Municipality, to which previous references have been made in the ELECTRICAL REVIEW, has at last been decided. The station is to be erected near the King's New Market, in the most central part of the town, where all the principal shops, cafés, and pleasure resorts are situated. The Royal Opera is also to be lighted by electricity. The dynamos will be capable of feeding 10,000 glow lamps. The installation, which is modelled upon those of Hamburg and Deptford, will cost about £80,000. The annual expenditure is estimated at £10,800, and the receipts at £15,200, there being thus a profit of £4,400. A glow lamp of 16 candle-power is to cost, inclusively, 4½ öre (½d.) per hour, whereas the cost of a gas jet of equal strength is just half; the electric light will therefore be a luxury. It is not considered that the electric light will affect seriously the use of gas, which is also supplied by the city; but the Municipality was of opinion that it could supply the light more effectively than private *entrepreneurs*.

Apropos of Fredensborg Castle, this well-known Royal residence now boasts also the electric light, 80 glow lamps having been fitted in the great banquetting hall, and the light will be extended to other parts. The other night the Royal dinner table, with all its occupants, were photographed by the light.

The electric light is also to be introduced into the city of Flensborg, a syndicate having obtained a concession for 10 years, when the city is at liberty to take the works over.

On the Danish mainland—Jutland—the telephone has been extended extraordinarily in recent years. Thus, not only all larger towns are now connected, but every little village has its local installation. Soon, also, there will be direct connection between the west and east coast. In addition, the State has laid a telephone net all along the west coast, round the Scaw, and down the east coast, whereby every fishing hamlet and lifeboat station has become connected with the rest of the country, a boon which need not be enlarged upon. Having established a certain connection, the State places the same in charge of the local authority for working and maintenance.

From the report just issued of the Danish telegraphs in 1888, it appears that the trunk lines were increased with 14 and the branch lines with 61 miles, making the total at the end of the year respectively 582 and 1,577 miles. The *personnel* consisted of 730 operators, &c. A total of 1,525,268 telegrams were transmitted, yielding £34,700, which is an increase upon 1887 of 19 per cent. The greatest correspondence took place with this country.

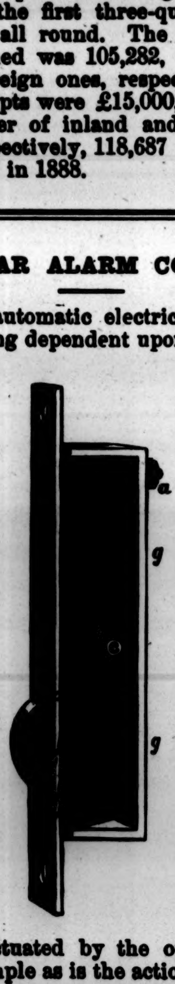
Although Sweden is far in advance of her Scandinavian sister countries in respect of the development of electrical inventions, Norway is making fair progress, considering the smallness of her population and resources. It is particularly the telephone which is extended in Norway. For instance, in Christiania there are now over 2,000 subscribers and 2,325 apparatus, the daily conversations numbering about 10,000. The telephone company here has obtained permission to extend the net to all districts round the city, as well as to the town of Moss, the charge thither being 6½d. per message. A number of tourist resorts in various parts of the country are also being connected by telephone. It may, by the way, be of interest to state that excellent telephone and telegraph apparatus is now being produced by the Electrical Bureau of Christiania, reported to be quite equal to that formerly imported.

Important negotiations are in progress between the German and Norwegian Governments for the purchase by the former of the direct German-Norwegian telegraph cable from Höyer, in Schleswig, to Arendal. By the terms of the concession, the German Government has the right of purchasing this cable at three months notice.

Finally, the returns of the Norwegian telegraphs are of interest just now, on account of the great reduction in rates which took place at the beginning of the year. The returns for the first three-quarters of the year show an increase all round. The number of inland messages despatched was 105,282, against 91,135 in 1888, and the foreign ones, respectively, 54,575 and 53,387. The receipts were £15,000, against £12,800 in 1888. The number of inland and foreign messages received was, respectively, 118,687 and 61,455, against 102,535 and 60,097 in 1888.

COX'S BURGLAR ALARM CONTACT PIECE.

THE efficacy of automatic electric alarms is perhaps more than anything dependent upon the action of the contact piece actuated by the opening of a door, window, &c. Simple as is the action of such a contact, the mere separation of two springs kept together by the door or window when closed, there are points of detail, or the arrangement of the same, which practical electricians will recognise as requiring to be dealt with. The method, of which we give an illustration, devised by Mr. Cox, is a very practical form of contact, and is as good a model as could well be designed for the purpose. The general pattern is what may be called of the "door furniture" description, *i.e.*, it is similar in appearance and make to the lock fittings for ordinary doors.



The fig. shows the arrangement; *g* is a brass box (one side being removed to show the internal fittings); the front part of this box, *h*, forms the fastening plate, as in an ordinary lock. This box is let into the door jamb to which the hinges are secured, or into the lower jamb of the window sash if the contact is to be used for a window alarm; *b* is a projecting piece forming part of the lever, *d*, which is hinged at *c*; the end of this lever is flexible, and is kept pressed against the insulated contact, *a*, by the action of the spring, *e*. The working of the apparatus is obvious; when the door or window is closed, the piece, *b*, is pressed back and moves the flexible end of the lever, *d*, away from the contact, *a*, breaking the circuit and causing the alarm to sound in the ordinary manner. The whole of the fittings being boxed in and the contact being a rubbing one, certainty of action is practically assured.

ELECTRIC TRAIN LIGHTING.*

By CHARLES SELDEN.

SOME months since your committee on papers to be read at this meeting assigned to me the subject of "Train Electric Lighting," since which time I have been availing myself of every opportunity, when coming into contact with either system in use, or parties exploiting them, to glean all the information possible, and I have therefore put myself in the way of meeting a number of electrical people.

I have found it a much greater task than I had expected, not only on account of the systems involved, but particularly on account of the claims of the various parties in regard to the system in which they were interested, and especially in dynamo schemes, one of which are so numerous.

The storage battery companies give the impression in their circular that it is their system which is being used upon the Pullman limited trains of the Pennsylvania Railroad Company, and their agent stated to me at their principal office that their battery in connection with the "Barrett System" was being used entirely by the Pullman Company, and that the Pennsylvania Railroad Company was using their storage batteries to the exclusion of all others. Upon investigation, however, I found that the Pennsylvania Railroad Company is using some of the "Julien" cells, but a majority of their cells are from the New York Accumulator Company, and upon investigation with the Pullman Company I found that they are *not* using the "Barrett System," and that while they are using a number of "Julien" cells, it is also true that they are using a number of the Accumulator Company's cells.

Whenever I attempted to get down to figures with any of these exploiters or promoters, I was always met with a general answer which was of no use whatever to us in contemplating the introduction of such a system upon our roads. By travelling first and carefully noting the devices employed, and then conferring with manufacturers, I became conversant with what ordinarily would be the worst of such things as were in sight, and I am now able to offer you, for probably the first time that it has been done, the *maximum*

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* Read before the Association of Railway Telegraph Superintendents of America.

figures upon at least one system (this is the system employed by the Pullman Company, and which I designate as system No. 1), and from this we can deduce the cost of one other (system No. 2).

I made several trips on their trains, and observed the working of this system in all its particulars, spending the better part of three nights run in watching, both in the baggage car as well as others, and it was very satisfactory indeed, the light being brilliant and everything that could be desired.

On a recent trip to Chicago I called upon the chief electrician of the Pullman Company, who very kindly accompanied me to Pullman, showed me through their plant, and gave me valuable information. There are some points in this system, however, which were not explained to me, for the reason that there are pending patents; but this *does not enter into the matter of cost*, and I was told that it was only in protection to their company that many matters were not at this time made public.

I have examined the Boston and Albany system partially, but as that is purely storage battery affair, I cannot report results in figures until facts are obtainable upon which I can stand and feel assured that the figures which I give will at least not represent a cost less than we would find if put into practice; the figures I herewith give you are therefore *maximum*.

In practice this subject can well be considered under the head of three systems:—

1. Lighting cars by the joint use of dynamo and storage battery.

2. Lighting cars by means of direct current from the dynamo.

3. Lighting cars by means of charged storage battery.

System No. 1 is in use by the Pullman Palace Car Company upon its limited New York and Chicago trains, the vestibuled trains of the Atchison, Topeka and Santa Fe Railroad Company and others.

To explain system No. 1 (and it has more or less bearing upon all of the systems), I think it best to commence upon the car.

By experience it has been deemed best to place the wire on top of the cars. For this purpose there is a moulding run along from end to end upon the roof of the car, and branch mouldings extend to points over the panels between the ventilators of the car. The latter arrangement is used for day, smoking or other coaches, where it is desirable to have the lamps suspended from the bracket on the side of the car, instead of forming part of the lamp fixture which is in the centre. The main wires or leads are covered in this moulding, along the top of the car, and branches therefrom are either dropped down through the air tube of the ordinary lamp (where centre suspension is desired) or led through the panel noted above, where it is desirable to have a bracket. On top of this moulding is placed another, and then all of this moulding is tinned over and securely soldered, so that there is no leakage into the car, and the wires are fully protected. They are also free, in a great measure, from any movement by reason of oscillation or jarring, and hence the chances for abrasion of the insulation are reduced to a minimum, while at the same time they can be gotten at much more easily than though they were placed between the roof and the head lining.

While it is true that the wiring of a sleeper (on account of the greater number of lights employed) is greater than that of a day coach, the average cost per car, fitted with the best wire, is about $100. This includes labour.

A "Brotherhood" engine directly connected with an "Eickemeyer" dynamo, both of them being upon the same cast iron bedplate, is placed within a lattice work enclosure at the forward end of the baggage car, occupying a corner between the end door and the side door. Ordinarily this space is 3½ feet by 5½ feet. This engine is fed by steam from the locomotive, the steam gauge within the baggage car usually showing a pressure of 60 lbs., of which 15 is exhausted through the pipe for heating the train. The dynamo has an electromotive force of 68 volts, and has 60 ampères at 800 revolutions per minute. It should be understood that at 900 revolutions the same machine would give you 80 volts and 80 ampères. A good dynamo of this capacity will give plenty of light for 120 lamps throughout the train, and is considered an economical one, for the reason that it has margin enough to serve a longer train than usually carried, so as to meet emergencies, should they arise. The Eickemeyer dynamo, while first class in all respects, is especially so for train service. The lattice work has a door, and is also open at the dynamo end, so as to admit of placing a tachometer belt upon it, and arranging for the adjustment of brushes, should it become necessary; but upon the runs I made, it was not necessary to adjust the brushes, and there was no sparking at the brushes, even under full load—a most desirable point in favour of this type of machine.

Both the engine and the dynamo are fed by an automatic lubricator, which is placed against the side end of the car, and carries sufficient oil for one or two round trips, and having small service pipes extending to the oil cups, feeding them regularly, without the attention of an engineer, other than to see that they are properly started at the beginning of the run.

Against the side of the car is placed a steam gauge, showing the pressure received from the engine, another steam gauge showing the amount of steam going into the heating pipe through exhaust, an ammeter, a voltmeter, a test lamp and a tachometer, the practical use of which will be shown later on.

There is a connection device for connecting the cars together, so arranged that should they part it will be released, as is now the case with the air brake pipe. I have thus been full in the explanation regarding the baggage car, because it is, of course, the key to the whole situation.

Each car carries in a box, securely fastened to the bottom of the car, 32 cells of storage battery, and under the system of distribution this storage battery is partly in use at all times, furnishing, when the dynamo is running, 30 per cent. of the power given to the lamps, and when the dynamo is not running, furnishing all the power. Thirty-two cells are used for the reason that the lamps used in this system are all of a high voltage, namely, 63, the weight complete of the battery and its boxes being 1,300 lbs. per car.

During the day, or at other times when the lights are not in use, the dynamo is run a number of hours charging these storage batteries, so it is unnecessary to remove them from their location under the cars for a long term, dependent, ordinarily, upon whether or not they have been in a wreck, or by long use the plates have become buckled, when, of course, it is necessary to remove such plates and put the battery in good condition.

It is claimed that with this system the storage batteries last longer than where they are subject to removal for recharging at the end of each trip. Whether this is true or not is a question which experience alone would determine; but I am inclined to the opinion that the statement is correct.

This system, as in vogue, has an attendant ($90 per month and board while on the train), who is more or less experienced in electric lighting, and at terminal stations—that is to say, Chicago and New York—an expert ordinarily inspects the condition of the electric service prior to the train leaving, and at the station at Pullman they have also an electric light plant, which is utilised for storing electricity for their cars placed in the shop and which are about to start out on the road.

The above will, I think, give you a clear idea of the general method employed.

The arrangement of the engine is so concise that I do not see why the baggage master should not be able to run it, after a little coaching, without any other attendant. For instance, if we have a gauge for steam from the engine with a notice under it that "This gauge should stand 65," and under the ammeter, "This gauge should stand at 63," and under the tachometer, "This gauge should stand at 800," it seems to me that any one with the least bit of common sense and a little bit of drilling would surely be able to run the plant, for (as can be explained to him) if with the cock fully open steam should get below the point which you mark and call his attention to, he is to call on the engineer for more steam. If the revolutions should fall below 800 it would at once call his attention to the steam gauge, and if the voltmeter or the ammeter should show out of proportion, the test lamp in the baggage car, or the other lamps in the baggage car, would become dim, thus calling his attention even though he were otherwise engaged. If the engine men cannot give him more steam, there is but one thing for him to do, namely, cut off the dynamo entirely and fall back upon the storage battery for the light for the train. This, I think, would complete all I have to say at present upon System No. 1, the expense of which I show in full later on in this paper.

The system of lighting direct from a dynamo upon a train, without the auxiliary help of a storage battery, is not in use, but I confess that I do not see why it would not be a good thing to do and save the expense both in plant and the depreciation of the storage battery. There is an objection, of course, that in case of any failure, either in connections, engine or dynamo, the lights would go out, leaving the train in darkness. This, however, could be obviated, I think, by keeping one coach candle in each car lit, or one lamp in each car lit; it is necessary to carry lamps or candles anyhow for emergencies. It is also necessary when the steam heat fails to employ as before the Baker or other heater for your cars, so that whether your lamps are lit or not, as a matter of fact there are many times when you have oil in your cars and you have fire in them.

The efficiency of dynamos in this day, and especially the one noted, is such that I do not think there will be a failure on account of either the dynamo or the engine amounting to one per cent. of the time of its use, while should a derailment occur, I cannot but believe that the storage battery will be just as apt to be rendered useless by breakage as well as would the other mechanism.

System No. 3 is employed by the Pennsylvania Railroad Company, the Boston and Albany, and some others. I have been unable, as yet, to get any figures as to the cost. This system consists in merely placing upon each car a number of cells of storage battery (the cost of each cell ranging from $9.00 to $12.00) which are usually charged at the terminal points, the batteries then being trucked to the cars and placed therein, running one trip and then being trucked out for recharge.

The Pennsylvania Company uses a small number of cells (12 to the car), and a low voltage lamp, namely, 23 volts. They claim to get 16 candle-power to each lamp, but I hardly think they do this. The lamps that I have seen seem to be of less candle-power, and they seem to use a smaller number than are necessary to properly light the car for reading. Ordinarily they carry seven lights in the body of the car of 23 volts, one in the smoking room of 22, and one in each hallway or approach of 24 volts, making in all 10 lights to the car. With the Pennsylvania Company, at the time of my examination, these lights were employed only in their parlour cars. The best report I could get from that company was to the effect that they really do not know what the lights cost them, that it had never been figured down in a fine way. They have power and electric light stations at Jersey City, and they use a portion of that power for storing currents during the daytime, while at the same time the same power was employed at night in lighting their yards, &c., &c., so that it was a hard matter to get at, but they had determined that while the light was a little more expensive than oil, at the same time it was cheaper than gas as used formerly, which was placed in retorts underneath the car.

What I here say as to the cost of this system (*i.e.*, lack of absolute knowledge) is true of all roads using it so far as I could learn from those questioned.

The author then gave some observations and remarks in tabulated form upon the cost of lighting various types of car, but as English railway practice is so essentially different to that in the States, the data would not be of much service to our readers.

SIR WILLIAM THOMSON'S CHAIN OF ELECTROSTATIC VOLTMETERS.

By ANDREW W. MEIKLE, M.A.

IN this paper it is proposed to give a description of a chain of electrostatic voltmeters invented by Sir William Thomson, and also to give an account of the methods employed in standardising them. These voltmeters have the great advantage of being available as accurate measurers of potential on direct and alternating systems, and, being electrostatic, they use no current, and consequently require no temperature correction. They are therefore free from the causes of error so prevalent in instruments of the electro-magnetic type, whose accuracy is impaired by variations of temperature, and which when used on alternating systems are affected by errors due to self-induction varying with the period of alternation. The chain of electrostatic voltmeters measures from 20 to 50,000 volts, and is composed of three distinct types—viz., the multicellular electrostatic voltmeters, the vertical scale electrostatic voltmeters, and the electrostatic balance.

The ranges of the separate instruments, as usually made, are :—

		Volts.		
Multicellular electrostatic voltmeter	range	20	to	100
	best of range	25	„	75
„ „ „	range	40	„	160
	best of range	50	„	100
„ „ „	range	60	„	240
	best of range	70	„	130
„ „ „	range	80	„	400
	best of range	100	„	240
„ „ „	range	200	„	800
	best of range	300	„	600
Vertical scale „ „	range	400	„	8,000
„ „ „ „	„	800	„	12,000
Electrostatic balance	„	2,500	„	50,000

The vertical scale voltmeter has been in use for about three years, but as the demand for it has lately increased since high potential systems have become so numerous, a few words of explanation about its construction and standardising may not be out of place here. It has therefore been included along with the later types in the present description.

Before describing the instruments separately, it may be well to notice some points which concern them all.

The instruments are made on the principle of an air condenser, having one of its parts movable about an axis, so as to increase or diminish the capacity. The condenser is enclosed in a metal case, for the double purpose of protecting the movable part from air currents, and from the disturbing influence of any electrified body, other than the fixed portion, differing from it in potential. In all the instruments, except the electrostatic balance, the fixed portions consist of two sets of quadrant-shaped cells in metallic connection with each other, and formed by a number of parallel brass plates. These cells are fixed by an insulating support to the case of the instrument, and a terminal passes from them to an insulated binding screw on the outside of the case.

The movable portion in all the instruments is in metallic connection with the surrounding case. In the multicellular voltmeters this connection is made through the suspending wire, and in the vertical scale voltmeter and electrostatic balance through the knife edges which support the movable part. The movable portion carries the pointer which indicates by direct readings the difference of potential between the two parts of the condenser.

The action of the instrument, shortly stated, is as follows :—When the fixed and movable plates are connected respectively to two points of an electric circuit, between which there exists a difference of potential, the movable part tends to move so as to augment the electrostatic capacity of the instrument, and the magnitude of the force concerned in any case is proportional to the square of the difference of potential by which it is produced. In the case of the vertical scale and electrostatic balance instruments this force of attraction is balanced by the horizontal component of a weight of any convenient amount hung on a knife edge in connection with the movable part, while, in the case of the multicellular voltmeter it is balanced by the torsion of the suspending wire.

The Multicellular Electrostatic Voltmeter.

The arrangement of the parts of this instrument is shown in figs. 1 and 2. These figures apply to an early form of the instrument, and differ in two matters of detail from the voltmeter as now made. For simplicity in manufacture the cells are now made with straight backs, and the plates looked at in plan are, therefore, triangular instead of square, as shown in fig. 2. A coach spring has now been interposed between the suspending wire and the spindle carrying the vanes, as explained below.

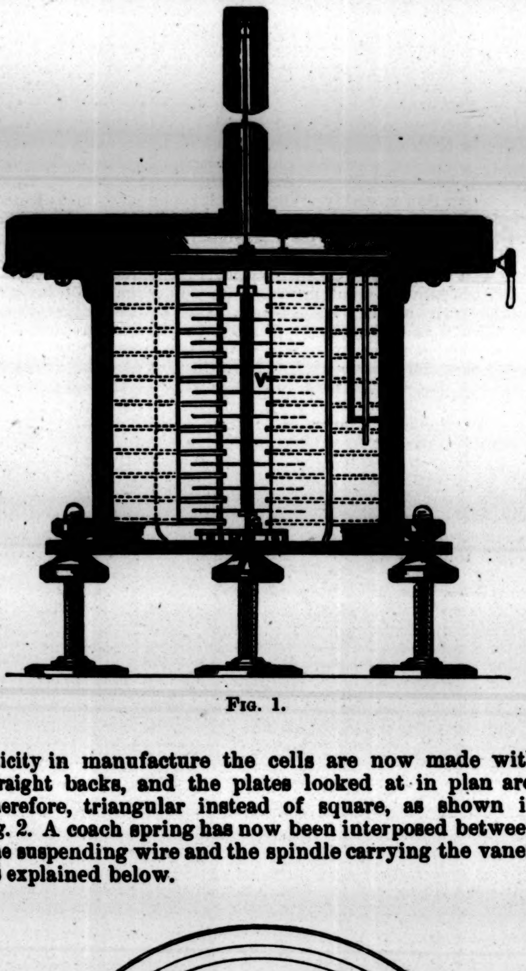


FIG. 1.

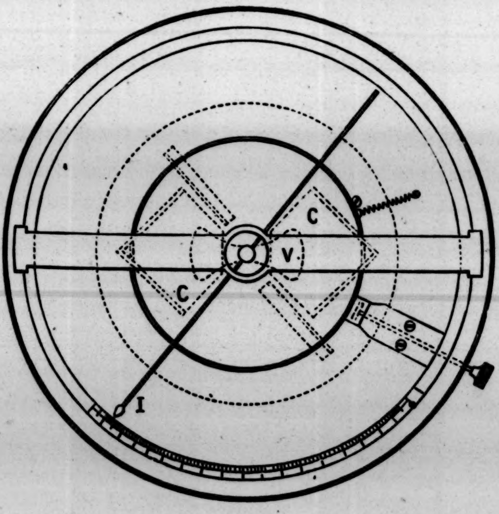


FIG. 2.

The insulated cells are formed of triangular brass plates fixed into saw cuts in a brass back piece so as to be equal distances apart and accurately parallel to each other. Two sets of these cells, C, are fixed relatively to each other, as shown in fig. 2, by a vulcanite support to the sole plate, so that their plates are horizontal, and are completely enclosed within the brass cylindrical case of the instrument.

On the top of this cylinder is a shallow horizontal circular scale-box containing the scale of the instrument, and having a glass cover, which serves to protect from currents of air the movable indicator, I, and the scale and interior parts from dust. For the movable part a number of vanes, V, similar in form to those of the quadrant electrometer are used. These vanes are placed parallel to each other on a spindle with distance pieces between them. The top end of this spindle passes through a small hole in the sole-plate of the instrument, which forms the bottom of the scale-box, and is attached to a small coach-spring, which in turn is secured to one end of a fine irridio-platinum wire suspended from a torsion head at the top of a vertical brass tube. The torsion head may be turned by means of a forked key provided for the purpose, and is clamped, to protect it from accidental displacement, by a cap which screws on to the end of the tube. The coach spring has sufficient resilience to allow the spindle to touch a guard stop, and so saves the suspension from injury in the event of the instrument being roughly set down. Two vertical brass repelling plates, which also act as guard plates to prevent the movable part from turning beyond its prescribed limits, are fixed to the bottom of the sole plate. These two plates carry a guide plate, G, with a circular opening in it, through which the lower end of the spindle passes. A little brass disc, D, or head, is attached to the end of the spindle, sufficiently large to prevent its passing back through the hole in the guide plate. Thus the movable part is effectually secured from swinging about so as to be injured, and by no possibility can it come into contact with the insulated quadrants. When the instrument is level the spindle hangs free by the suspending wire, so that the vanes are horizontal, and each is in a plane exactly midway between those of two contiguous condenser plates. To facilitate the use of the multicellular as a portable voltmeter a small thumbscrew is placed in the centre of the base plate below the instrument, which can be screwed in so as to lift the weight of the spindle and vanes from the suspending wire, and clamp the disc on the end of the spindle against the guide plate. An aluminium needle, I, attached to the top of the spindle indicates, on the horizontal circular scale fixed to the upper side of the sole plate, the difference of potential between the movable and fixed portions of the condenser by direct readings in volts. To enable this multicellular to be used as an inspectional instrument capable of being read from a distance, as across an engine-room, a

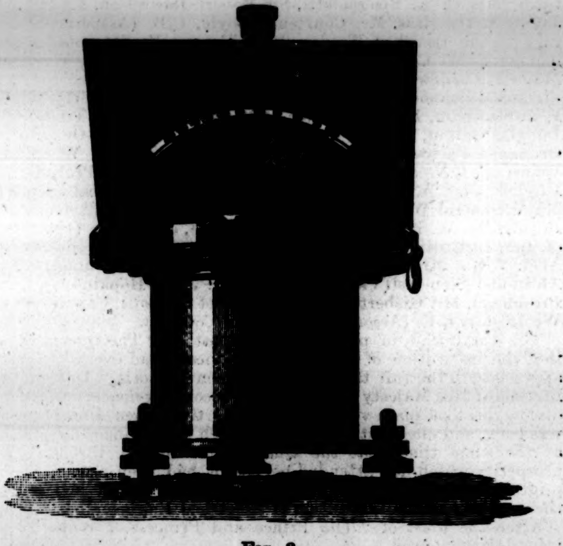


FIG. 3.

mirror, supported in a frame which passes over the vertical brass tube, and rests upon the glass cover of the instrument, is supplied. When this mirror is in position, it is at an angle of 45° with the plane of the sole plate, and by reflecting the scale and pointer, gives the instrument all the advantages of a vertical scale. The instrument is shown in fig. 3, with its mirror in position. (*To be continued.*)

THE INSTITUTION OF ELECTRICAL ENGINEERS.

Last Monday evening the first annual dinner of this institution took place at the Criterion Restaurant, Sir W. Thomson, the President, occupying the chair. Among those present were the Marquis of Salisbury, Sir G. Gabriel Stokes, M.P. (President of the Royal Society), Mr. Latimer Clark, Sir Frederick Bramwell, Prof. G. Carey Foster, Mr. Justice Stirling, Prof. W. Grylls Adams, Sir James Kitson (President of the Iron and Steel Institute), Mr. C. E. Spagnoletti, Sir Robert Rawlinson, K.C.B., Sir James N. Douglass, Mr. Courtenay Boyle, C.B. (Assistant-Secretary to the Board of Trade), Prof. George Forbes, Staff Commander E. W. Creak, R.N., Prof. J. A. Fleming, Dr. W. Pole, Major P. Cardew, R.E., Mr. Harrison Hayter, Mr. James Forrest, Sir David Salomons, Mr. Alfred Giles, M.P., Prof. J. Perry, Major F. A. Marindin, R.E. (Inspector of Railways, Board of Trade), Sir Douglas Galton, K.C.B., Dr. W. Anderson (Director-General of Ordnance Factories), Mr. Edward Graves, Captain W. J. L. Wharton, R.N. (Hydrographer to the Admiralty), Prof. D. E. Hughes, Prof. A. W. Reinold (President of the Physical Society), Major-General Webber, C.B., Mr. W. H. M. Christie (Astronomer Royal), Mr. W. H. Preece, Sir John Coode, K.C.M.G. (President of the Institution of Civil Engineers), and Sir Frederick A. Abel, C.B., Mr. R. E. Crompton (Member of Council), Mr. Alexander Siemens (Vice-President), Dr. John Hopkinson (Vice-President), Mr. Gisbert Kapp (Member of Council), Captain A. E. Wrottesley, R.E. (Associate-Member of Council).

The Chairman, in proposing the toast of "The Queen," said that the Institution of Electrical Engineers had every reason to appreciate to the full the reign of Queen Victoria. During the lifetime of Her Majesty electricity had become a science. Œrsted's discoveries took place very nearly at the time when Her Majesty was born, and electricity became a branch of engineering almost at the same time that the Queen came to the throne. The prosperity which had attended her reign had been shared, of all professions, most notably by those whose development had led to the existence of the Institution of Electrical Engineers.

After the toast of "The Prince and Princess of Wales" had been duly honoured,

The Chairman proposed "The Army, Navy, and Reserve Forces." He said that it seemed as if the Army and Navy were to become year by year more and more electrical. The telegraph department attached to the Army had long connected the land forces with electricity, and 30 years ago the laying of the great submarine cables seemed to indicate that an electrician, unless he were a sailor too, was almost useless. Electrical science formed the foundation of the knowledge of scientific officers of both services, and now no less than 70 members of the institution belonged either to the Army or the Navy. The Navy, at a very early period, was connected with the branch of engineering which had led up to the foundation of the society, hydrography, one of the foundations of submarine cables; he was proud to think that the electrical departments had done something towards promoting hydrography. The great use this has been put to was the investigation of the bed of the ocean; in fact, to such an extent, that it enabled the engineer to choose where to lay his submarine cables. The very exigencies of submarine telegraphy had added to the usefulness of the investigations of the department of hydrography in all the governments.

Major-General Webber, in responding for the Army, said the application of electric science to the art of war formed an interesting subject of study. What, for instance, would have been the effect upon the tactics adopted at Waterloo if the armies of Wellington and Blucher had been in telegraphic communication. The benefits of the measure of 1870, by which two companies of Royal Engineers were sent to be trained in telegraphy at the Post Office, had been evident in every small war that this country had since undertaken.

Captain Wharton, in responding for the Navy, said that electrical science had played a large part in the development of the British Navy. The most important contribution of the science was to be found in the electric search lights, without which no ironclad would be safe against the attacks of torpedo boats. In ships, of all things else, the electric light was especially valuable, and it had long been adopted in the Navy. Sir William Thomson himself had done good work for the Navy, not only in regard to the laying of telegraph cables, but also in regard to his compass and sounding apparatus.

The Chairman then proposed "Her Majesty's Ministers," the toast being received with loud cheers. He said that it was due to the action of Her Majesty's Government alone that men were able to live in peace, practise their professions, and cultivate their sciences. Through the prosperity which the Government brought to the country those investigations and good works could be carried on, the pursuit of which was the object of the institution's existence. The country ought to be obliged sufficiently to those who were willing to conduct for them the business of legislation; but how much more gratitude should the nation feel to those who undertook the actual burden of the State? The excessive labour and responsibility they underwent was appalling. Every member of the Government had some private occupation which he would like to pursue; and what must electricians think of the man who forsook electricity for government, who might be working in all the beauties of electrical science, following them, investigating them, and making discoveries in them, were it not for the higher duty which called him to take up the government of the State in the interests of the nation? Lord Salisbury was one of themselves in the sense of being a scientific electrician and an electrical engineer. All must appreciate profoundly the honour which the Prime Minister had done the institution in being present at its first dinner at the end of the first year of its existence.

The Marquis of Salisbury, who was received with prolonged cheering, said, in response:—Sir William Thomson and Gentlemen,—I have to thank you on behalf of my colleagues in the Government and myself for the exceedingly kind reception you have given to the kind words in which Sir William Thomson has proposed this toast. I do not feel that I can accept the guise in which he put my name forward. On the contrary, though recognising, as every individual must do, and as I have especial reason to do, the enormous benefits which electrical science confers upon mankind, I feel that I have reason rather to apologise for my appearance in this assembly. When I look round on so many learned and distinguished men, I feel rather in the position of a profane person who has got inside the Eleusinian mysteries. (Laughter.) But I have an excuse. The gallant gentlemen who replied for the Army and Navy were able to show many particulars in which their special professional vocation was sustained and pushed forward by the discoveries of electrical science. But I will venture to say that there is no department under the Government so profoundly indebted to the discoveries of those who have made this science as the Foreign Office, with which I have the honour to be connected. I may say that we positively exist by virtue of the electric telegraph. The whole work of all the chanceries in Europe is now practically conducted by the light of that great science, which is not so old as the century in which we live. And there is a strange feeling that you have in communicating constantly and frequently day by day with men whose inmost thoughts you know by the telegraph, but whose faces you have never seen. It is something more than a mere departmental effect which these great discoveries have had upon the government of the world. I have often thought that if history were more philosophically written, instead of being divided according to the domination of particular dynasties or the supremacy of particular races, it would be cut off into the compartments indicated by the influence of particular discoveries upon the destinies of mankind. Speaking only of these modern times, you would have the epoch marked by the discovery of gunpowder, the epoch marked by the discovery of the printing press, and you would have the epoch marked by the discovery of the steam engine. And those discoveries have had an influence infinitely more powerful, not only upon the large collective destinies, but upon the daily life and experience of multitudes of human beings than even the careers of the greatest conquerors or the devices of the greatest statesmen. In that list which our ignorance of ancient history in its essential character forbids us to make as long as no doubt it might be made, the last competitor for notice and not the least would be the science of electricity. I think the historian of the future when he looks back will recognise that there has been a larger influence upon the destinies of mankind exercised by this strange and fascinating discovery than even in the discovery of the steam engine itself, because it is a discovery which operates so immediately upon the moral and intellectual nature and action of mankind. The electric telegraph has achieved this great and paradoxical result, that it has, as it were, assembled all mankind upon one great plane where they can see everything that is done, and hear everything that is said, and judge of every policy that is pursued at the very moment when those events take place, and you have by the action of the electric telegraph, combined together almost at one moment, and acting at one moment upon the agencies which govern mankind, the influences of the whole intelligent world with respect to everything that is passing at that time on the face of the globe. It is a phenomenon to which nothing in the history of our planet up to this time presents anything which is equal or similar, and it is an effect and operation of which the intensity and power increases year by year. When you ask what is the effect of the electric telegraph upon the condition of mankind, I would ask you to think of what is the most conspicuous feature in the politics of our time, the one which occupies the thoughts of every statesman, and which places the whole future of the whole civilised world in a condition of doubt and question. It is the existence of those gigantic armies held in leash by the various Governments of the world, whose tremendous power may be a guarantee for the happiness of mankind and the maintenance of civilisation, but who, on the other hand, hold in their hands powers of destruction which are almost equal to the task of levelling civilisation to the ground. What gives these armies their power? What enables them to exist? By what power is it that one single will can control these vast millions of men and direct their destructive engines at one moment on one point? What is the condition of simultaneous direction and action which alone gives to these vast armies this tremendous power? It is nothing less than the electric telegraph. And it is from that small discovery, worked out by a few distinguished men in their laboratories upon experiments of an apparently trivial character, on matter and instruments not, in the first instance, of a very recondite description—it is on that discovery that the huge belligerent power of modern States, which marks off our epoch of history from all that has gone before, must be held, by any one who investigates into the causes of things, absolutely to depend. I would venture to hope that this is not all, in its great effect upon the history and government of our race, that electricity may achieve. Whether it so far is good or evil in the main, it must be for the future to determine. We only know that the effect, whatever it is, will be gigantic. But in the latter half of the short life of this young science another aspect of it has been developed—an aspect which I cannot help hoping may be connected with great benefits to the vast community of industrious and labouring men—I mean that facility for the distribution of power of which electricity has given such a splendid instance. The event of the last century was the discovery of the steam engine. But the steam engine was such that the forces which it produced could only act in its own immediate neighbourhood, and therefore those who were to utilise its forces and translate them into practical work were compelled to gather round the steam engine in vast factories, in great manufacturing towns, and in great establishments where men were collected together in unnatural and often unwholesome aggregation. Now an agent has been discovered by which the forces of the steam engine, stiff, confined to its own centre, can be carried along, far away from its original sources to distances which are already great, and which science promises to make more considerable still. I do not despair of the result that this distribution of forces may scatter those aggregations of humanity, which I think it is not one of the highest merits of the discovery of the steam engine to have produced. If it ever does happen that in the house of the artisan you can turn on power as now you can turn on gas, and there is nothing in the essence of the problem, nothing in the facts of the science, as we know them, that should prevent such a consummation from taking place—if ever that distribution of power should be so organised, you will then see men and women able to pursue in their own homes many of the industries which now require the aggregation at the factory. You may, above all, see women and children pursue these industries without that disruption of families which is one of the most unhappy results of the present requirements of industry. And if ever that result should come from the discoveries of Œrsted and Faraday, you may say that they have done more than merely to add to the physical forces of mankind. They will have done much to sustain that unity, that integrity of the family upon which rest the moral hopes of our race and the strength of the community to which we belong. These are some of the thoughts which electricity suggests to one of my trade. Pardon me if I have wandered into what may seem to be speculative and unfamiliar fields. But after all, the point of view from which we must admire the splendid additions to our knowledge which the scientific men of the world, and especially of England, during this century have made, is that they have enabled mankind to be more happy, to be more contented, and therefore to be more moral.

Sir FREDERICK ABEL, C.B., past-President, proposed the toast of "The Learned Societies," coupled with the name of Sir George Gabriel Stokes, M.P., President of the Royal Society.

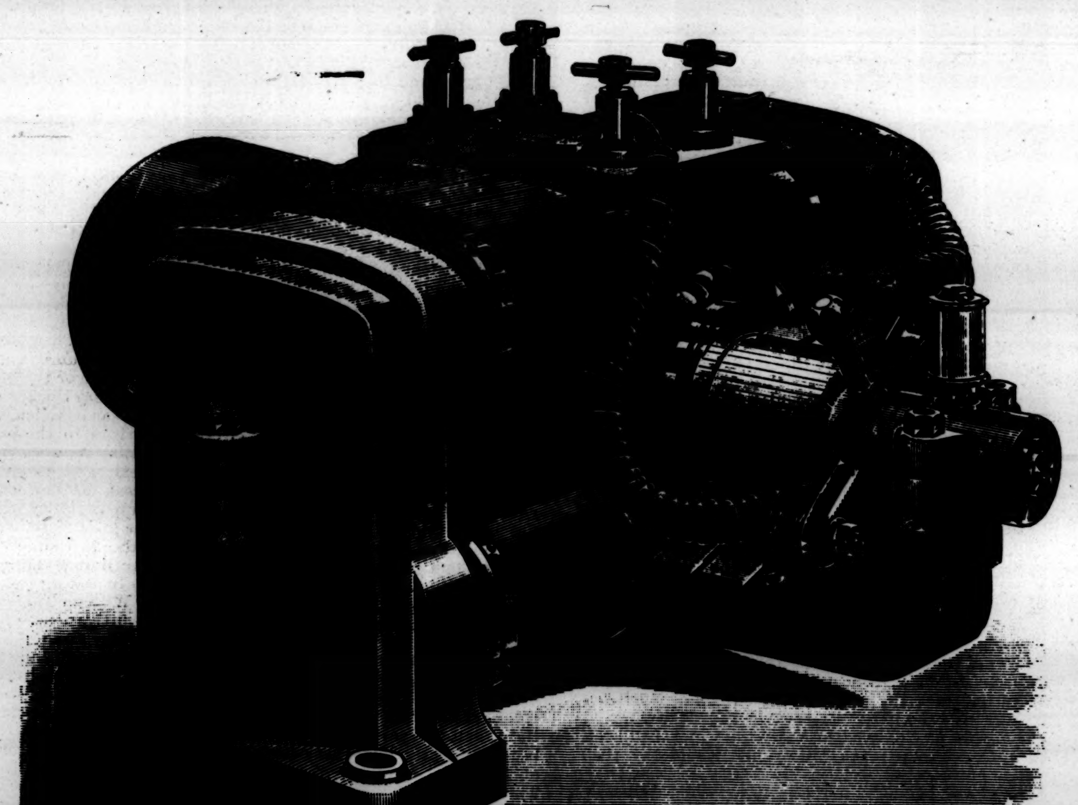
Sir GEORGE STOKES, in responding, said that the Royal Society was the oldest scientific society in the kingdom. For a long time it was the only scientific society, and took under its consideration all branches of science. There were now many societies upon which the Royal Society looked with parental affection; but it so far retained its old constitution that it received papers on all subjects of science. He did not know to which of the categories—the learned societies or the professional societies—they considered themselves as belonging. If they looked at the great achievements in supplying the needs of daily life which had been effected through the agency of electricity, one would say that institution was a professional society. In that very room they had an example of the beautiful electric light which had now become tolerably common, and of which in all probability they would see a good deal more in London. Nowadays the whole earth resembled in a measure one of our own bodies. The electric wires represented the nerves: the messages were conveyed from the most distant regions to the central place of Government just as in our bodies sensations were conveyed to the sensorium; and then, again, the orders were issued. If those applications were alone considered it seemed as if that institution was a professional society. But they must look to the manner in which those results had been produced since the first discovery. He could not help going back to the laboratory in Albemarle Street, where the great Faraday made so many of his discoveries. He could not help remembering how deeply their president went into the mathematical theory of the electrical actions which take place in submarine cables, and how the success of that first great experiment of spanning the Atlantic was largely indebted to him for his investigations. Therefore he could not look on that society simply as a professional society. He considered that it formed the connecting link between the scientific and the professsonal.

MR. LATIMER CLARK (Past-President) proposed the toast of "The Professional Societies," to which Sir JOHN COODE (President of the Institution of Civil Engineers) responded.

The MARQUIS of SALISBURY next rose to propose the toast of "The Institution of Electrical Engineers." He said:—Sir William Thomson and Gentlemen,—As your toastmaster has told you, the toast of the evening has been committed to my charge, though I fear that the lateness of the evening will prevent me from doing it that justice which it deserves. The toast is that of "The Institution of Electrical Engineers." It is now a very interesting moment in the life of the Institution of Electrical Engineers. It is, I understand, your first convivial meeting, and an institution which dines for the first time may be looked upon as a child that has just been weaned. (Laughter.) Well, the simile is not so improper, because it has just taken to its bottle. (Laughter and cheers.) But all I can say in its behalf would be pale compared to the consciousness of its merits which must inhabit the minds of all its authors, and they must feel that I should be profaning a sacred subject if I were to attempt to go into those technical details by which alone its merits could be sufficiently illustrated. But I feel that a paper which has been put into my hands will, at all events, illustrate what great need there was for an institution of this kind, and what splendid possibilities there are for it in the future. I am told that it contains nearly 1,700 members, though it is not a year old, and that it represents the science of electricity, its application to telegraphy, land and submarine, to telephony, to electric lighting, to the transmission of power, locomotion by electric railways, tramways, and omnibuses. Now, this vigorous infant is obviously the child of the institution represented by Sir John Coode. He may look upon himself, when I read this paper, as the possible father of a tremendous offspring (laughter and cheers), for it is evident that this institution will not remain barren. It will increase by what I believe physicists call gemmation, and there will be cut off from it from time to time new institutions representing each one of the copious subjects which I have read. There is evidently, therefore, a great destiny for it in the future; but I think those who have founded it have been wise not to introduce that process of subdivision too soon. It is very well that these various kindred societies should remain together for some time longer, and that that cordiality which distinguishes learned societies should be encouraged in the future by the close association and companionship of their early days. It is indeed a splendid sphere of activity which such a list as this points out for the science of electricity, and those who have to give it practical effect. It is a splendid career which it opens to all to whom the maintenance and application of this science is confided. I cannot, whenever I attend, as I occasionally have the privilege of doing, any assemblage of scientific men—I cannot help comparing with a melancholy feeling the endurance and permanence and almost eternal existence of their work with the transitory effect of the work of the profession to which I belong. Politicians may do good or they may do harm. They hardly know what result destiny will give to their actions. They do not know how the Divinity will shape the ends which they are trying to rough-hew. They cannot so measure the causes which act on the formation of human events and human history as to judge of the permanence or the transience of their work. With you it is otherwise; every brick which you add to this great pile will last as long as human consciousness endures; every atom which an electrician brings to the great science which he cultivates will remain there doing its work right to the end, as long as the intellect of man exists by which the science can be applied. It is, therefore, a great destiny which your institution has before it, and a great responsibility which lies before you. In asking you to drink to the good fortune and good health of this institution I will ask you also to couple with it the name of one who, more than any other living man, has given to electricity its power and its fame. In asking you to drink to it, in conjunction with the name of Sir William Thomson, I add the name of one whose marvellous investigations, whose extraordinary inventions, and the singular accuracy and practical character of whose science, have been felt by every one present in the practical carrying out of his work. If Faraday or Wheatstone have begun this work, the historian will record that no stronger hand ever existed to carry on the sacred flame to future generations than the hand of the distinguished and gifted man who has been your president this evening. I give you "The Institution of Electrical Engineers," joined with the name of Sir William Thomson.

Sir WILLIAM THOMSON, in responding, said that in proposing the health of "The Queen," he felt that the reign of Queen Victoria and the history of electricity as a branch of applied science were synchronous to a most unique degree. The science of electricity was as old as human learning. In the remotest times Greek and Arabian philosophers had something of our present electrical knowledge. Last century was full of work of pure electrical knowledge, but what was most remarkable was the tremendous development it had received since 1819. In 1837 the electric telegraph came into existence, and although he did not say it was invented by Cooke and Wheatstone, it became a practical servant for man through their labours. One very remarkable piece of work they should think of especially this year, and during the last few weeks, when they deplored the loss of one of the greatest workers in electrical science and its practical application that the world had ever seen—Joule. The great scientific discoveries of Faraday, which were prepared almost deliberately for the purpose of allowing others to turn them to account for the good of man, had been going on for about 15 years, when a young man took up the subject with a profound and penetrating genius most rare in any branch of human study, and perceived relations with mechanical power which had never been suspected before. Joule saw the relations between electricity and force, and his very first determination of the mechanical equivalent was an electrical measurement. His communication to the British Association when it met in Cork in the year 1841 pointed out for the first time the distinct mechanical relation between electric phenomena and mechanical force. Joule was not a mere visionary who saw and admired something in the air, but he pursued what he saw to the very utmost practical point of work, and he it was who determined the mechanical equivalent of heat. Afterwards he thoroughly confirmed the principle of his first determination of the mechanical equivalent of heat. Both in electricity and mechanical action he laid the foundation of the great development of thermo-dynamics, which would be looked upon in future generations as the crowning scientific work of the present century. It was not all due to Joule, but he had achieved one of the very greatest monuments of scientific work in the present century. For an Institution of Electrical Engineers it was interesting to think that the error relating to one of the most important electrical elements, the unit of resistance (now called the ohm), as determined electrically in the first place by a committee of the British Association, and by purely electrical method, was first discovered by Joule's mechanical measurement. It was Joule's mechanical measurement which first corrected the British Association unit, and gave the true ohm. The Institution of Electrical Engineers had not come into existence exactly like Minerva; it began with the Institution of Telegraph Engineers in 1870, and it had during the subsequent 19 years been growing up, until it had at last become the great institution of Electrical Engineers which it now appeared to be. He thanked them most warmly for the great honour they had done him in choosing him as their first president, and for the way in which they had received his name in connection with the toast which Lord Salisbury had just put before them.

The company then separated.



THE ROPER DYNAMO AND ARC LAMP.

THE engraving represents a type of dynamo recently introduced by Messrs. J. and W. Roper, of Trafalgar Street, Bradford. The machine is of a good, strong, and substantial design, and the armature is built up of sheets of soft Swedish iron, separated from each other by a special insulating material, and fitted upon two sliding "spiders," each of which has three arms of a little more than half the length of the armature running parallel with the shaft.

One of these rests against the face of a fixed solid collar on the shaft, whilst the other is loose on the shaft so as to be screwed up tight by means of a large nut. The bearing arms have no bolts or joints, and there is no danger of their shaking loose. The brasses in which the shaft runs are very accurately fitted, particular attention being paid to this point, which the makers consider to be of great importance.

A brass disc is fitted on the framework of the armature, revolving with it; this protects the connections of the armature to the commutator and adds also to the appearance of the machine.

Two joints only are made in the magnetic circuit, and the sectional area of the field magnets is maintained throughout. These machines are wound to a standard voltage of 110 and 60 volts respectively.

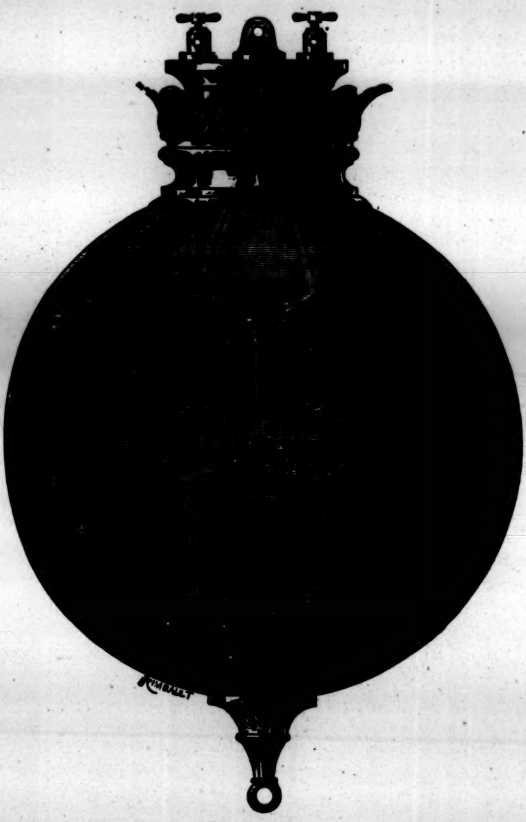
The drawing shows the machine lagged; this, however, was at the special request of clients, and air space is allowed for.

We also illustrate Messrs. Roper's "short" arc lamp, to which they desire to call particular attention.

The makers claim for this an extreme compactness, the whole of the works being contained in a tube 6 inches long, and 6 inches in diameter. They say that it is "absolutely impossible for the lamp to overfeed under normal conditions." There is no lamp rod at all.

Messrs. Roper have been exclusively engaged in the manufacture and fixing of electric lighting plant for the last seven years, and have paid special attention throughout to their dynamos and arc lamps. They have upwards of 50 complete plants regularly at work in Bradford and district alone, and their works for the last three or four years in the winter months have been kept running from 6.30 a.m. to 9 and 10 p.m. The firm has a great number of contracts in for complete plants, and also many orders for dynamos and arc lamps for both England and abroad; and a dynamo for a capacity of 1,300 lights, one of a pair, is just being commenced. The average sized dynamo turned out by Messrs. Roper is 300 lights (18,000 watts); and amongst their contracts is a machine of 39,000 watts (650 lights), for Messrs. Prince, Smith and Son, of Keighley, where they are fixing 20 of the new "short" arc lamps of 4 and 5,000 C.P. each, and also glow lamps.

So far as the works are concerned, Messrs. Roper have every facility for the entire manufacture of both large and small dynamos. Three years ago they fixed a special engine of 120 I.H.P. for the testing of dynamos, which is used for no other purpose. There is a separate department for the manufacture of the patent arc lamps which, for the last six years, have been made in large quantities.



ATKINS'S UNIVERSAL SHADE CARRIER.

AMONG the details which trouble the electric lighting contractor is the unsatisfactory method provided by many fitting makers for carrying electric shades and globes ; a carrier of different design has been provided for each class of globe or shade involving the use of a variety of lamp-holders and sometimes even a *mélange* of loop and capped lamps in the same installation. The result of such complications is as annoying to the client as it is to the contractor, for the task of removing the shades for cleaning is quite beyond the capability of the ordinary domestic, and they are consequently allowed to remain dirty.

The Atkins's patent carrier (illustrated) appears to overcome these objections ; it is serviceable for shades of any shape or size, and it clasps or releases the shade by a single motion of the thumb and finger, so that shade cleaning need no longer be a difficulty. The action is shown in fig. 2 ; the flat brass triple eccentric ring is guided centrally by three pins working in slots, the three claws are carried by slides working over the eccentric ring, the cam action of which causes the claws to advance or recede together.

Two sizes are at present made, the small, fig. 3, to carry shades with 1⅛th inch to 1¼th inch hole, and the large, fig. 1, to suit globes with 3 inches opening ; the larger pattern is also made with the claws reversed to carry the flanged globe or shade which is so extensively used for gas. The Electrical Accessories Company is making these carriers in a variety of ornamental designs, and there is no doubt that they will come largely into use, for the idea is an admirable one.

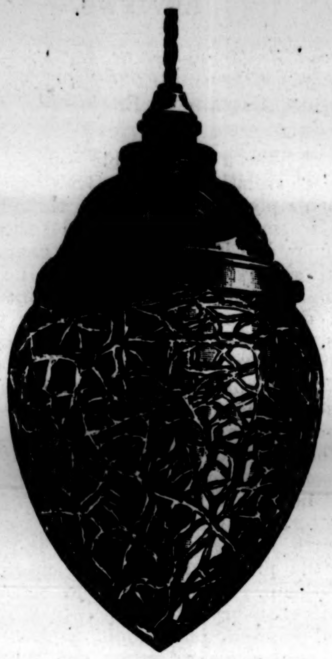


FIG. 1.

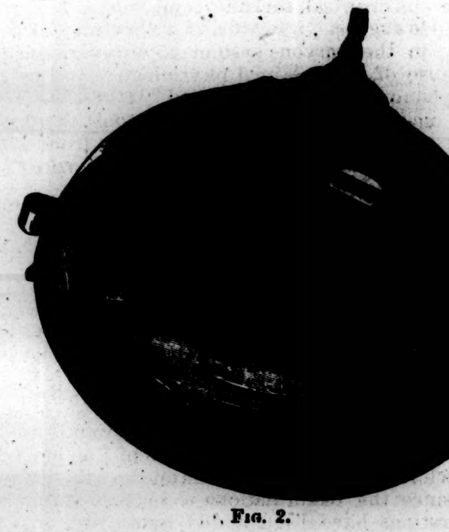


FIG. 2.

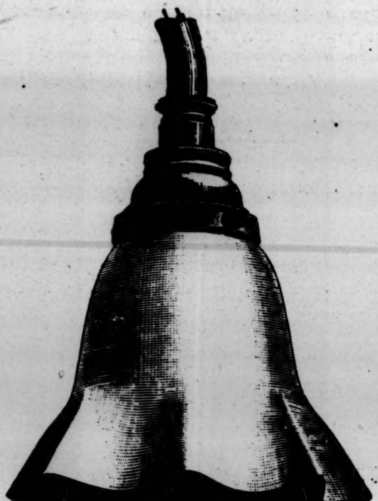


FIG. 3.

REVIEWS.

*Energy and its Transformations, Mechanical Power, Heat, Light, Chemism, Electricity, Magnetism.** By R. COLSON, Captain of Engineers. Paris: George Carré.

This work bears a considerable resemblance to Sir W. Groves's "Correlation of Physical Forces" as far as general principles are concerned, though with regard to the application of these principles the course of recent discovery has introduced many changes.

The author's first chapter treats of the classification of phenomena and of the forms of energy in accordance with the impressions which they produce upon our senses, and seeks to give a simple notion of energy.

In the two following chapters we find a study of the principal transformations of energy with an examination of the conditions under which the transition of one form to another is effected.

These forms are, of course, thoroughly well known. We may congratulate Captain Colson on the circumstance that he makes no attempt to identify life with any of the forms of energy.

The fourth chapter contains an inquiry into the origin of the principal forms of energy which are available to man. In the fifth and sixth chapters we find a general theory of thermic, luminous, chemical, electric and magnetic phenomena, whilst in the seventh chapter we find a general summary. Here the author recognises that electricity and magnetism are not manifested to our senses by any peculiar and novel effects other than mechanical, thermic, luminous and chemical effects. He suggests, however, that they may exert an action upon the nervous system of animals, and may be the cause of unexplained physiological and psychological phenomena. The so-called "ether," or transmissive medium, he thinks may be constituted by a remnant of the original cosmic matter from which nebulæ and worlds have been gradually formed by a process of condensation.

The book would be greatly improved by the addition of an index.

Electrical Engineering. Systematically Arranged Questions on Telegraphy and Telephony, Electric Lighting, and Transmission of Power. By Prof. JAMIESON. London: Charles Griffin and Company, Exeter Street, Strand. Glasgow: Messrs. Morgan and Company, 129, Sauchiehall Street.

This pamphlet contains all the Ordinary and Honours Questions set at the City and Guilds of London Institute's Technological Examinations on the subjects mentioned, since the examinations were first instituted; other questions have been added by the author. The compilation will be welcome to many and especially to those who are working for the City and Guilds examinations. A key either giving answers to the questions or showing exactly in what books, and on what pages of those books, answers may be found, would be a useful addition.

THE ELECTRIC LIGHTING SITUATION IN NEW YORK.

THE New York *Electrical Review* says on Monday, October 28th, the two local companies—the Brush Illuminating and the United States Illuminating—were still not supplying arc electric lights. These companies are rapidly improving their lines, pending the decision in their injunction cases against the Board of Electrical Control.

The East River Electric Company, using the Thomson-Houston system, both arc and alternating, and the Manhattan Electric Company, using the Fort Wayne arc and Slattery alternating systems, have been running constantly, the former supplying 600 arc and 4,000 incandescent lamps. These companies, comparatively new comers in the field here, did not have to contend with the poor construction of early electric lighting days, but have built their lines of the best modern fire and weatherproof wires, and have seen that the work was approved by the proper authorities. From what we have seen of the construction done by the East River Company under the direction of General Manager John G. Moore, it is evident that neither expense nor pains have been spared to make the lines safe, and not a single accident, to our knowledge, has been recorded against them. The joints—those points of danger—are triple coated with black tape, which is securely tied on each side of the joint with fine wire, so that peeling off becomes almost impossible. Another point is in the specially made cross-arms, in which the pins are set out from the pole on each side, giving the lineman more room in his work.

The older companies in their later work have realised the necessity of the best construction, and if permitted to proceed with the work now commenced, will soon have all their lines overhauled. There is still a great deal of the construction of early days that will have to be changed. There are several reasons why this change has heretofore been a slow one—the chief one being, probably, the expectation of soon being compelled to go underground. Then, besides, it is claimed that it was very difficult to get permits to repair lines that needed attention, and many points of danger caused by bare wires resulted.

The electric lighting interests of the country need not feel discouraged over the situation here. There have been some serious accidents, and the public has been badly scared, yet we think when every facility for perfect overhead construction has been adopted, there will be no accidents, and the danger reduced to the minimum.

Mayor Grant, in his opposition to the resolution reducing the pressure to 300 volts for alternating currents, and to 700 for continuous currents, deserves the thanks of everyone who believes in electric lighting and its good work, irrespective of any systems. Such action would be most unjust and unnecessary. Modern construction, carefully and regularly inspected, is what is needed. All the accidents, so far, were preventable ones.

NOTES.

Hastings and the Electric Light.—The Hastings Town Council has renewed the existing contract with the local electric light company for the lighting of the front line from the Queen's Hotel to Warrior Square, for £450 per annum.

China will have Electric Lights.—We hear a Chinese syndicate for introducing the electric light into the Flowery Kingdom has been formed in Chinatown, San Francisco, with a capital of £1,200,000, part of which is furnished by white investors.

Irish Electric Lighting.—At Grove House, County Tipperary, Ireland, the residence of Mr. Richard Burke, the popular Master of the Tipperary Hounds, the electric light is being installed on an extensive scale. The light is being introduced through the dwelling house, out-offices, stables and kennels. The installation consists of a steam engine, Elwell-Parker dynamo and set of accumulators, the whole calculated to run about 100 lamps at a time. Electroliers of a handsome and costly character are provided for the reception, and other principal rooms, and elaborately mounted switchboards for controlling the main and branch circuits. The whole of the installation is being carried out according to the specification and under the immediate superintendence of Messrs. J. K. Fahie and Son, electrical engineers, of Dublin.

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* *L'Energie et ses Transformations Mécanique, Chaleur, Lumière, Chimie, Electricite, Magnetisme.*

Electric Light at Exeter Theatre.—We hear the electric light at Exeter theatre is not working altogether satisfactorily. Inadequate machinery at the central depôt is the explanation given. Another engine will shortly be purchased.

Edinburgh and Electric Lighting.—A special meeting of the Edinburgh and Leith Corporations Gas Commissioners was held on Friday afternoon, "to consider the question of electric lighting, and if so agreed to resolve to apply to the Board of Trade for a license or provisional order to supply electricity within the area of the Commissioners, or within some part or parts of the same, in terms of the Electric Lighting Acts, 1882 and 1888." The Lord Provost presided. The Lord Provost stated the object of the meeting, and read the recommendation of the Works Committee held on 21st October. The minute of the committee was as follows :—"There was laid before the meeting a copy of an opinion obtained by the Board of Trade from the Lord Advocate, on a case submitted by the board, as to who is the Local Authority for electric lighting purposes within the district of the Commissioners under the Electric Lighting Act, 1882, by which the Lord Advocate has advised the Board of Trade that, in his opinion, the Corporations, as Police Commissioners, are the respective Local Authorities for the purposes of that Act. The meeting, having taken the Lord Advocate's opinion into their consideration, recommend the Gas Commissioners, at the meeting appointed to be held on the 1st November next for the consideration of the question of electric lighting, to adhere to their resolution refusing the Commissioners' consent to any company obtaining powers within any part of the Commissioners' district; and the meeting further recommend the Commissioners to resolve to oppose any application by any company for such powers—leaving it to the Corporations to deal with the question as they think fit, in consequence of the Lord Advocate's opinion—and to co-operate with the Corporations in any action which they may resolve to take." Councillor Colston thought there was only one course that they could pursue, and that was to confirm the minute of the Works Committee, and he moved accordingly. It was quite clear that as a Gas Commission they were placed in this position that they could adopt no other course than that which the Works Committee suggested. Bailie Turnbull seconded the resolution, and said they could hardly doubt that they must keep this matter in their own hands, and not allow it to come into the hands of any other party. After further discussion the resolution was unanimously adopted.

Oldham Applies for the Light.—At a special meeting of the Oldham Town Council on Tuesday it was resolved to make an application to the Board of Trade for a provisonal order to supply electricity for public and private purposes within the area of the municipal borough.

Electric Lighting at Portsmouth.—The movement in favour of the electric light is progressing favourably at Portsmouth, and the name of Edwin Hide, Chairman of the Chamber of Commerce, has been added to the directorate of the Local Electrical Supply Company, which is in course of formation. The agents of the House-to-House Electric Supply Company, Kensington, are actively canvassing the borough, and with such good results that up to the present over 1,500 lights are required.

Electric Lighting at Ventnor.—At this week's meeting of the Ventnor Local Board, the Clerk announced the receipt of a communication from the Electric Communication and Maintenance Company, Lambeth, asking the board what steps they intended to take relative to an application which they had made for supplying electricity within the Local Board district. It was unanimously decided to offer every opposition to that or any other electric lighting company who might seek for lighting powers within the area of the board.

The Proposed Electric Tramway between Bournemouth and Poole.—At a vestry meeting recently held at Kinson, it was unanimously resolved :—"That the sanction of this vestry be hereby given to the scheme brought forward by Mr. Haynes for the construction of the tramway from the Sea View Hotel to the country gates in the parish of Kinson." The Kinson ratepayers have also passed a resolution pledging themselves to do all in their power to support the movement.

Guadeloupe-Martinique Cable.—W. T. Henley's Telegraph Works Company, Limited, is making cable for connecting the French colonies of Guadeloupe and Martinique. The cable will be laid before the end of the year.

Birmingham Exhibition Closes in Pugilistic Style.—The exhibition closed in somewhat noisy fashion; the crowd did as they liked, smoked, drank, fought, and the doors were fastened amidst a scene of great disorder.

Electric Cars in Milan.—It is said the La Società Anonima degli Omnibus (The Anonymous Omnibus Company), of Milan, some time ago selected three engineers to travel through Europe to inspect the various electric traction roads in operation, and report on the adaptability to their tramways in Milan. The commission was unable to make a report on any line that was a complete financial success. A careful study was made of the different types of accumulators in use at present, and an estimate is made of the comparative cost of storage battery traction as compared with that of horses.

Paisley.—The Council will petition Parliament for provisional orders to enable them to light the town by electricity.

The Legion of Honour.—In the latest list published of Englishmen who have received honours we note the following :—Grand Officer of the Legion of Honour—Sir Wm. Thomson. Officers of the Legion of Honour—Mr. W. H. Preece, F.R.S., and Mr. J. Aylmer. Officers of Public Instruction—Mr. Conrad Cooke, Mr. C. V. Boys, F.R.S., and Mr. W. H. Massey.

Wiring Tables.—Woodhouse and Rawson United, Limited, are now prepared to supply their wiring tables to the public at the following rates :—Printed on plain paper, 1s.; printed on canvass, varnished and mounted on rollers, 1s. 6d.

The Edinburgh Exhibition.—Considerable progress is being made with the arrangements for the International Electric and Inventions Exhibition to be held in Edinburgh next year. A deputation from the Executive Council waited on Monday upon the Council of the Institution of Electrical Engineers, with reference to various suggestions connected with the adequate representation of electrical science. The following names, among others, have already been added to the London Committee, under the presidency of Sir Henry Isaacs, Lord Mayor elect, and the chairmanship of Sir George Hayter Chubb :—Sir John Lubbock, M.P., F.R.S.; Sir Henry Roscoe, M.P., F.R.S.; Sir Philip Cunliffe Owen, K.C.B., K.C.M.G., C.I.E.; Sir Frederick Abel, C.B., F.R.S.; Sir Charles Mills, K.C.M.G., C.B.; Sir Arthur Blyth, K.C.M.G., C.B.; Sir F. Wyatt Truscott; Baron de Bush; E. M. C. Braddon (Agent-General for Tasmania); Captain Shaw, C.B.; Colonel Gouraud; and Mr. W. H. Preece.

It is announced that Mr. Edison, who is one of the Vice-Presidents, has promised to exhibit samples of the extensive and unique collection which he sent to the Paris Exhibition. A number of other interesting exhibits now at Paris will also be transferred to Edinburgh. It is proposed to close the list of applications for space on the 1st December, a large proportion being already applied for, and the Executive are determined to have the building and contents complete by the opening day. Amongst the exceptional facilities afforded to exhibitors will be that of having their goods conveyed on rail direct within the exhibition grounds.

Electrical Business in Leeds.—We understand that Mr. Wilson Hartnell is lighting a number of the mills in this district, one of which is the beautifully-situated mill at Burley, with which the late W. E. Foster was connected. The Dewsbury Town Hall is another important installation recently completed by Mr. Hartnell.

The Gillett Telephone.—These instruments, which have been manufactured and sold by the Electric Telephone Company since 1884, are now being made of better material than formerly, and are finished in better style, the prices remaining the same. The design and construction are as simple as possible, and there is nothing to render them liable to get out of order. For short lines between different departments of factories, from offices to works, or lodge gates to mansions, they have been found to answer all requirements, and the fixing is so simple that, with the printed instructions accompanying the instruments, the operation may be entrusted to any workman.

Cable Ships.—At a recent Maritime Conference held at Washington, an amendment to the Rules of the Road was carried, providing that lights in globular lanterns carried by cable ships shall possess a two miles' sight power.

Electric Supply for Malvern.—A number of Malvern gentlemen have formed a provisional company for the supply of electricity for lighting and other purposes, and the necessary capital has been subscribed. The *Malvern Advertiser* speaks of the scheme in a very hopeful manner, and we wish the promoters of the movement every success.

Telegraph Materials Wanted.—The Midland Railway Company requires telegraph instruments, wire, &c. Patterns, &c., which can be seen only at the General Stores Department, Derby, are now ready for inspection. The Cheshire Lines Committee also requires during 1890 telegraph materials, instruments, wire, &c. Further particulars may be obtained upon application to Mr. Barton, Storekeeper, Cheshire Lines, Warrington.

The India-Rubber World and Electrical Trades Review.—This is the title of a new journal published in New York, and judging from the excellently-arranged first number which has just reached us, there is a wide field before it. One little extract from the editorial announcement serves to point a moral and adorn a tale :—"Upon one point we are anxious that there should be no misunderstanding whatsoever ; the reading and editorial pages of this paper are not for sale." We notice that Mr. Herbert Laws Webb contributes the first portion of an article on "Insulated Wires."

A Grim Suggestion.—A correspondent to an American daily paper writes as follows :—"Why not put an end to the discussion concerning the effectiveness of electrical execution by condemning convicted murderers to serve as linemen for electric light companies."

Teachers and Students.—Mr. Varley requests us to say that his reply to Professor Perry will not be ready in time for our present issue.

A Refractory Patent.—The following appears amongst recent American patents :—"The combination, in a resistance device, of a refractory tube containing a refractory resistance material, and inclosed in a refractory casing." This is sufficiently refractory for a reformatory.

The Institution of Electrical Engineers.—The first ordinary general meeting will take place on Thursday, November 14th, 1889, when a paper will be read by K. L. Murray, member, "On the Lighting of the Melbourne Centennial International Exhibition."

Tenders for Electric Lighting.—Estimates for a complete electric light installation for works in Queen's Road, Victoria Docks, E., for Messrs. W. Goodacre and Sons, Abbey Mills, West Ham, E., are required.

Personal.—Sir George Elliot, M.P., has been appointed chairman of the Telegraph Construction Maintenance Company, in place of the late Sir Daniel Gooch. Sir George Elliot has been a director of this company since its formation.

Electric Tramways in Madrid.—*Industries* says it is announced that before the close of the year the Bilbao and Portugalete tramway will be worked by electricity. At the same time the Madrid Stations and Markets Tramways Company are going to try the accumulator system. It is feared that the management of these trials is not in proper hands, being somewhat of an amateur character, and it is most likely that it will end in failure, which will put off for a long time any further trials.

Telephones in America.—It is stated that the 3,200 telephones in Detroit, Mich., are used 80,000 times a day, and give employment to 60 young women.

American Electric Companies.—An American contemporary says : A large interest in the Brush Electric Company is said to have been purchased by the Thomson-Houston Electric Company. The practical purchase of the parent Brush Company will place the Thomson-Houston in full possession of all the Brush patents, and in a position to dictate the future policy of the Brush Company.

Telephones.—Messrs. W. H. Baughan & Co. inform us that they have recently introduced a new electric telephone which is well spoken of. They are said to be thoroughly reliable, guaranteed free from infringement of other patents, and the cheapest yet put on the market. Perhaps the firm will send us a set to inspect and try.

The Electro-Harmonic Society.—The second Smoking Concert of the season took place on Friday evening last, and was a pronounced success. Eight new members were elected, and eight more candidates for admission to the Society were proposed. Considering that the concerts were started with but few over 100 supporters, and that now the numbers have increased to about 280, we think that the popularity of these pleasant meetings speaks volumes in their favour. At the next meeting the fair sex will be privileged to join their lords and masters in the enjoyments of the evening.

Society of Arts.—The opening meeting of the Society of Arts will be held on Wednesday evening, November 20th, when an address will be delivered by the Duke of Abercorn, C.B., chairman of Council.

Close of the Paris Exhibition.—The Exhibition closed on Wednesday with a grand fête, attended by an immense crowd of 400,000 people.

The Silvertown Strike.—The position of affairs remains unchanged. Yesterday a large and orderly procession passed the offices of the company carrying banners.

Deaths that Don't Count.—The *Electrical World*, speaking of the recent accidents in New York, says :—"There were 35 deaths from gas in this city last year, but not a single newspaper has had space enough to mention the fact, their columns being crowded with details of one death by electricity. There were over 100 deaths from vehicles in the street, but one may hunt in vain for any reference to the fact just now. Fifty men in England went to their death at once in an English colliery last week, but the New York papers dismissed the matter in a brief item, and England goes on coal mining.

Busy in Electrical Work.—We are pleased to note that several firms are full of work in the engine departments.

London Chamber of Commerce.—The Electrical Trades Section will meet on Monday to consider the action to be taken at the Edinburgh Exhibition.

An Invitation.—Mr. Jarman writes :—" If Mr. Harry Willis will meet me by appointment any day next week at the offices of the Electric Tramcar Syndicate, Limited, 31, Lombard Street, between the hours of 11 and 1 (Monday and Saturday excepted), and state the object of his enquiry in last week's ELECTRICAL REVIEW, I will answer the questions he is 'curious to know.' "

Dundee Electric Lighting.—After various pleasant trips and much consideration, the Corporation is about to apply for a provisional order.

Large Works.—The Edison Machine Works' new plant, at Schenectady, N.Y., grows rapidly. Already some 1,300 men are employed, and when the plant is completed probably twice that number will be required.

NEW COMPANIES REGISTERED.

Transvaal Oil Engine Company, Limited.—Capital £25,000 in £5 shares. Objects: To acquire certain patent rights for inventions in relation to petroleum engines, under an agreement with the Hamilton Syndicate, Limited. To carry on, in the Transvaal or elsewhere, the business of mechanical and chemical engineers, manufacturers of engines, and workers and dealers in electricity, motive power and light, and any business in which the application of electricity or any other power is or may be useful, convenient or ornamental. To trade and deal in electrical generators or accumulators, and all kinds of electrical and other apparatus and appliances. Signatories (with 1 share each): S. H. Blumfield, East Grimstead; W. J. Mayes, 7, Great St. Helens; A. H. Richardson, 8, Disraeli Road, Putney; A. J. Cooley, 51, New Cross Road; J. T. Keating, 151, Westerton Road, Tottenham; H. Williams, 39, Searob Street, E.; G. Strong, 20A, Dunstan Street, E. The subscribers are to appoint the first directors; qualification, 10 shares; remuneration, £50 per annum each, and in addition a divisible sum of £250 for each 1 per cent. dividend over 10 per cent. per annum, provided that £1,500 per annum be the maximum. Registered 5th inst. by A. H. Richardson, 8, Disraeli Road, Putney.

Priestman Oil Engine American Syndicate, Limited.—Capital, £25,000 in £10 shares. Objects: To purchase the Priestman's and Hume's patents relating to hydro-carbon engines for the United States, and to carry on business as engineers, and of makers and dealers in electric and motive power and lighting. Signatories (with 1 share each): *E. P. Maxsted; F. R. Pease, J.P.; *J. Reckitt; *J. Sherburn, J.P.; *H. Holt, J.P.; W. Dent Priestman, and *S. Priestman, all of Hull and neighbourhood. The signatories denoted by an asterisk, and of Joshua Priestman, are the first directors. Qualification, £500 in shares. Registered 5th inst. by Williamson, Hill & Co., 13, Sherborne Lane.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

British Tanning Company, Limited (tanning by electricity).—The statutory return of this company, made up to the 21st August, was filed on the following day. The nominal capital is £70,000 in £1 shares. 35,140 shares are taken up, upon which the full amount has been called. The calls paid amount to £33,458 10s., and unpaid to £1,681 10s. Registered office, 17, Basinghall Street.

Mudge Marchant Engine Company, Limited.—The statutory return of this company, made up to the 12th August, was filed on the 19th August. The nominal capital is £131,105, divided into 2,610 ordinary shares of £50 each, 50 "A" shares of 2s. each, and 120 "B" shares of £5 each. The shares taken up are 2,560 ordinary and 30 "A," the former being considered fully paid, and upon the latter £3 has been received. Registered office. 5 and 6, Great Winchester Street.

An agreement of 9th September, cites that under an agreement of 5th April with the founders of the company, it was provided that the founders should receive ordinary shares amounting in the aggregate to 2,560, in consideration of the assets brought into the company by them, which are taken to be of the value of £128,000. The present agreement confirms the previous document, and provides for the issue of the said shares credited as fully paid up.

Galloways, Limited (engineers and electricians).—The statutory return of this company, made up to the 14th August, was filed on the 20th August. The nominal capital is £250,000 in £100 shares; 2,108 shares are taken up, and the full amount has been called and paid thereon. Registered office, Knott Mill Iron Works, Manchester.

Woodhouse and Rawson United. Limited.—An agreement of 15th ult., filed on the 30th ult., between this company of the first part, Chas. L. Baker & Co., Limited (in liquidation) of the second part; Thomas Pilling and Thomas Horsfield, of Manchester (the liquidators), of the third part, states that, under an agreement of 15th July, it was arranged that the property, undertaking and business of Chas. L. Baker & Co., Limited, should be purchased by this company for £24,000, of which £19,000 should be paid by the allotment of fully paid preference shares or mortgage debentures. Under the present agreement 3,800 fully paid-up preference shares will be issued to the said liquidators of Chas. L. Baker & Co., Limited.

Electricity Company for Spain, Limited.—An agreement of 6th June, filed on the 17th ult., between P. A. Latham and Robert Hammond provides for the payment of all costs and legal charges incidental to the registration and formation of the company in consideration of receiving 100 fully paid founders' shares of £5 each. The shares will be entitled to one half of the surplus profits remaining after payment of a non-cumulative dividend of £7 per cent. upon the ordinary shares. This agreement is confirmed by an agreement of 4th October.

The statutory return of the company, made up to the 3rd ult., was filed on the 1st inst. The nominal capital is £100,000, divided into 19,900 ordinary and 100 founders' shares of £5 each. The only shares taken up are the seven subscribed for by the signatories to the memorandum and articles of association, and upon these no call has been made. Registered office, 15, St. Helen's Place, E.C.

Chili Telephone Company, Limited.—The statutory return of this company, made up to the 28th ult., was filed on the 30th ult. The nominal capital is £250,000 in £5 shares. 40,000 shares are taken up, upon which the full amount has been called. The calls paid amount to £160,025, and unpaid to £39,975; the unpaid calls being due on the 31st proximo. Registered office, 53, New Broad Street.

Chas. L. Baker and Company, Limited.—At an extraordinary general meeting of this company, held on the 6th September at the registered office, Broth Street, Manchester, it was resolved to wind up voluntarily, Messrs. Thomas Pilling and Thomas Horsfield, of Manchester, being appointed liquidators, with authority to carry into effect an agreement of 15th July between this company and Woodhouse and Rawson United, Limited. The resolutions were confirmed on September 23rd, and were duly filed on the 15th ult.

LEGAL.

United Telephone Company v. Smith.—Before Mr. Justice Chitty.—The plaintiffs in this case asked for an injunction to restrain Mr. Smith, of Leeds, from infringing their two patents for telephone instruments, for an order for delivering up the instruments in the defendant's possession, and an inquiry as to damages, with an order to pay the same, when ascertained, with costs, charges, and expenses as between solicitor and client. The case came before the Court on a motion for judgment in default of the defendant pleading. Mr. Justice Chitty made the order as asked.

CITY NOTES, REPORTS, MEETINGS, &c.

The Western and Brazilian Telegraph Company, Limited.

In the report of the directors to be presented at the eighteenth ordinary general meeting of the company, the total earnings amount to £86,555 17s. 10d., as against £86,874 7s. 11d., a decrease of £318 10s. 1d. compared with the half year to June 30th, 1888.

The working expenses amount to £39,104 15s. 5d., as against £32,813 7s. 10d., an increase of £6,291 7s. 7d.

The increase is attributable to the higher exchange and to the purchase of extra instruments and appliances, also to additional staff and their travelling expenses, necessitated by the prevalence of yellow fever on the coast, and by increased traffic. The Board have much pleasure in stating that the conduct of the staff under trying circumstances was beyond praise. The ss. *Buccaneer* was chartered to take the place of the ss. *Norseman*, which was ordered home for new boilers and repairs. The amount of cable used was also larger than usual during this half-year.

Including the amount brought forward from 1888 (£3,461 17s. 3d.) and the dividend received upon the shares held in the "Platino" Company to the 30th June, the balance to the credit of the revenue account is £58,237 19s. 8d., from which has to be deducted £13,500 for debenture interest, leaving £44,737 19s. 8d., of which £7,500 has been placed to the renewal fund, and £5,600 to the debenture redemption fund. This leaves £31,637 19s. 8d. The directors recommend the payment of a dividend on the ordinary shares for the half-year at the rate of £4 per cent. per annum (6s. per share), carrying forward £4,072 9s. 8d. At the corresponding period last year the dividend was at the same rate.

Since the last half year's report 545 "Platino" shares have been exchanged for 327 shares of this company.

The dividend will be paid on November 15th.

Although not, strictly speaking, applicable to the period treated of in the present report, the directors feel that the shareholders should be informed of what has taken place in reference to the proposed laying of loop or alternative cables.

The chronological order of the communications exchanged with the Government of Brazil is adhered to.

As early as February, 1888, the following message was sent to the Government through the then Minister of Agriculture:—

February 9th, 1888.—"In view of recent interruptions of cable communication between Rio and Pernambuco, owing to breaks in cable caused by *force majeure*, the directors of the Western and Brazilian Company propose immediately to procure and lay a loop or alternative cable between the points where these interruptions occurred so as to maintain continuous cable communication between Pernambuco, Bahia and Rio de Janeiro, also between Rio Grande and Monte Video. As this will cause great expense to the company, and be a great boon to the public and the Government, board of directors respectfully beg the co-operation and assistance of the Government as to landing places and so forth, and in the general carrying out of the measure."

On the 27th of the same month the following reply was received.

February 27th, 1888.—Minister of Agriculture's reply:—"Apparently understood by co-operation and help, pecuniary aid, and says, referring great expense, the company can have no claim on Government. Company having already 90 per cent. of traffic, prejudicial interest of State, therefore cannot admit such *claim as it is company's duty to preserve its system in condition to avoid interruptions to service*, nor can he permit any *change* of landing places as plans were already approved, and no plausible motive is shown for alternative," he adds: "that any benefit would be exclusively for the company."

To this the directors replied as follows *on the same day*:—

"The company fully admits the obligation to preserve its system in a condition to avoid interruption, hence the announcement of its intention to strengthen its means of communication made to the Government on the 9th inst. *The company quite realises that it will have to bear the entire expenses of the works they now intend to carry out, and will land cables at same landing places.*"

It is most important to note, that although the Government were thus in full possession of the company's proposals and intentions on the 27th February, 1888, no further communication or objection was received from the Government until July 26th of the present year, or not until 17 months had elapsed.

Meanwhile, in the report of the directors for the year 1887, openly published in April, 1888, the shareholders were informed of the intention to strengthen certain sections by laying loop cables.

In March, 1889, at a special general meeting, the agreement with the Brasilian Submarine Company, which included a condition that this company should lay these lines, was approved by the shareholders.

In May, 1889, the general meeting was held, and the directors were authorised to provide the necessary funds for the manufacture and laying of these cables. The position being thus far clear, the Government having been informed fully of the company's intention to lay loop cables, and having, in reply to this notification, distinctly advised the company that it was their duty to preserve their system in a condition to avoid interruptions to service, and every publicity having been given meanwhile to every step taken, the directors entered into a contract with the Telegraph Construction and Maintenance Company, Limited, for carrying out the work.

Three changes of Ministers had meanwhile taken place.

On July 26th, after an interval of 17 months, the cable being in course of manufacture, the directors were astonished to receive intimation that the cables would not be allowed to be laid without special permission.

On the 2nd of August the directors pointed out that the Government in February, 1888, had already made no objection to the proposed strengthening of the company's system, but on the contrary had strongly emphasised the duty of the company to keep up continuous communication at its own cost, no alteration being made in landing places.

On the 27th September the Director-General of Government Telegraphs in Brazil writes that he hears of ships coming out to lay these cables, and he repeats that it must not be done without special permission.

On the 2nd October the directors forwarded by wire a representation of the rights conferred under their concession and of the company's obligation to "maintain all their works, apparatus and cables in good condition, so that there may be no interruption in the transmission of telegrams along the whole length of the lines," and also pointed out that Article 1 of the same clause says:—"Should any interruption take place on one or both the lines of the company, the company shall use their best endeavours to restore the communication *in the shortest possible time.*" The board submitted in courteous terms the injury which would accrue to the undertaking if it were prevented from carrying on its operations in the manner best calculated to give the public a reliable service.

Meanwhile, the Minister of Agriculture, under date October 3rd, before receiving the above communication, on behalf of the Government, officially informed the company that permission to lay the alternative cables "is refused consequent upon information from the Telegraph Department, and having in view the agreement entered into between this company and the Brazilian Submarine Company."

The directors, on October 10th, quoted the articles of the concession, and respectfully pointed out that they were acting under its rights and obligations, and urgently invoked the "protection and aid" from the Government which it was promised under such concession.

The position, therefore, is now as follows:—

The company is prevented from taking the most effective steps to keep up communication so as "not to interrupt the transmission of telegrams" along the lines, and to "restore the communication in the shortest possible time," as required by the concession.

The concession granted by the Government of Brazil in 1873, and under which the company carries on its operations, distinctly pledges the Government to give the company "protection and aid," and provides for the most perfect working of the company's system as eminently desirable, whereas the prohibition to lay the loop lines would have the exactly opposite effect.

In 1873 Brazil was isolated telegraphically from the civilised world, and it was imperative for political, commercial and other important reasons that this isolation should be put an end to. On the other hand, a cable from Europe, involving enormous outlay, would not have been laid without the assurance that traffic would be certain to be forthcoming immediately, consequently it was provided and agreed that all the important ports in Brazil and the cable with Europe should be simultaneously joined together, and thus communication between Brazil and Europe was secured by several years sooner than could otherwise have been the case.

The letter and spirit of the concession, therefore, authorise this company to carry messages between the ports of Brazil and for other countries, and the directors are at a loss to conceive how the action taken, together with the present opposition on the part of the Government, which has for effect to prevent the best service being given to the public, is consistent with the promise of "protection and aid," and the original provisions and stipulations made to secure Brazil instantaneous telegraphic connection with the outer world—an object at that time of such supreme importance as to dwarf all other considerations.

The laying of the company's cable was received with public acclamation and rejoicing. His Imperial Majesty the Emperor assisted with his own hands at the landing of the shore ends, decorations were bestowed upon those who conducted the operations, and, in short, the laying of the cables was received as a great national boon. The company has from that day to this fully and faithfully carried out every obligation it undertook, in face of many obstacles, and despite the unlooked-for competition of the very Government under whose ægis the cable was laid, and the directors in submitting this report, leave it to the proprietary and public to judge of the treatment the company has received and is receiving.

In the meantime the directors have only actually ordered 338 miles of cable, which will be used in strengthening a portion of the company's system much subject to breakages from anchors, and not in Brazilian waters. A portion of the new cable has also been sold to the River Plate Telegraph Company, which connects Monte Video with Buenos Ayres. A recent interruption on that company's line cut off the traffic from Buenos Ayres, and your directors gladly arranged with the River Plate Company for the duplication of this important link in the system. The balance of cable, which will remain after the above operations, will be taken into stock in Brazil.

Under these circumstances, and in accordance with the provisions of the contract with the Telegraph Construction and Maintenance Company, no additional lengths of cable will for the time being be manufactured by that company, and no liability rests upon the company for the payment of any fine or compensation. The total outlay on the expedition engaged with the above 338 miles of cable is estimated not to exceed £37,000.

The further steps necessitated will depend upon the action of the Government of Brazil.

Shareholders unable to be present at the meeting are requested to sign and return the enclosed proxy, in time to be received at the company's office not later than Monday, the 11th day of November, 1889.

Brazilian Submarine Telegraph Company, Limited.

THE thirty-second ordinary general meeting was held on Wednesday at Winchester House. In the absence of Viscount Monck, Sir James Anderson officiated as chairman, who said he regretted that Viscount Monck was too unwell to attend that day. Turning to the report they would find £20,000 had been lost compared with the months of the previous half year, but taking the whole period they had a gain of £4,000. The great reduction in revenue was due to the interruptions of the Western Brazilian line, which had been numerous, though at the present time all the cables were working satisfactorily. Whether the necessary powers would be granted for the duplication of those lines was a knotty question. There was obstruction in the Brazils which had yet to be overcome. On the other side of the account they had a growing traffic, and £70,000 invested in the West African direct cables, which was earning a dividend. He congratulated the shareholders on receiving a good dividend, in fact, the best which had been yet paid. The reserve had been largely increased, and in his opinion, in the face of possible adverse circumstances, it ought at least to exceed half a million. The report and a dividend of one shilling per share, making altogether 6 per cent., and bonus of three shillings per share was then unanimously adopted.

Viscount Monck and the Duke de Loulé, who retired by rotation, were re-elected directors, as were the auditors.

The proceedings terminated with a vote of thanks to the chairman.

The West India and Panama Telegraph Company.

THE report of the directors for the half-year ended 30th June, 1889, to be submitted to the 25th ordinary general meeting, 13th November, 1889, runs as follows :—The amount to credit of revenue is £49,985 11s. 9d., and the expenses have been £24,458 6s. 9d., leavieg a balance of £25,527 5s., which, with the balance of £1,154 3s. 1d., brought from last account, makes a total of £26,681 8s. 1d. Of this sum the directors have placed £2,000 to reserve, leaving an available balance of £24,681 8s. 1d., with which it is proposed to deal as follow :—

	£	s.	d.
First Preference Shares—			
Balance of arrears of dividend, 6s. per share	10,368	18	0
Dividend, 6 months to 30th June, 6s. ,,	10,368	18	0
Second Preference Shares—			
On account of arrears of dividend to 30th June, 10s. per share	2,334	10	0
Balance to current half-year's account ...	1,609	2	1
	£24,681	8	1

The traffic receipts for the six months show an increase of £672 12s. 11d., as compared with the corresponding period.

The expenses for repairs to cables are £3,459 9s. 7d. less than those for the corresponding half-year, owing to fewer interruptions. The company's system is in good working order throughout.

The company's ss. *Duchess of Marlborough* arrived in the Thames in May last, after an absence of four years; and having been surveyed and repaired, in accordance with Lloyd's requirements, returned to the West Indies with a supply of new cable for stock.

The Swan United Electric Light Company, Limited.

IN the seventh annual report of the directors, to be presented at the ordinary general meeting of the company, to be held at the Cannon Street Hotel, London, on Thursday, November 14th, 1889, at 2 p.m., the accounts are presented to the shareholders for the year ending 30th September, 1889.

After paying all current charges, and making ample allowance for depreciation of plant, there is a credit balance of £21,042 8s. 1d., to which must be added the credit balance of £10,052 8s. 11d. brought forward from the last accounts, making a total of £31,094 17s. The directors will recommend the shareholders to declare a dividend of 6 per cent., which will absorb £22,206 0s. 9d., to be distributed to the shareholders in accordance with clause 77 of the articles of association.

The litigation in Germany still drags on, and, until some conclusion is arrived at, it is difficult to foresee whether a sound and remunerative business can be carried on in that country. The shareholders are aware that Germany is the only country on the Continent of Europe in which the company now manufactures and sells lamps.

The Compagnie Générale des Lampes Incandescentes have established a new factory in Paris, which was brought into work last July, in which lamps are now being manufactured on a considerable scale. During the first six months of its existence, the company worked under considerable disadvantages, having had to purchase the lamps required for their business, so that a small dividend only was earned, but there is every reason to hope that they will develop an increasing and profitable trade.

The directors who retire by rotation are Mr. J. S. Forbes and Mr. E. W, Batt, who, being eligible, will offer themselves for re-election.

Messrs. Welton, Jones & Co., the auditors, will also retire, and will offer themselves for re-election.

Woodhouse and Rawson United, Limited.—The directors have invited applications for the balance of the capital, on the following terms, viz :—10,000 ordinary shares of £5 each, at a premium of 5s. per share, payable 15s. per share on application, £1 on allotment, and £1 on February 1st, 1890. There is no present intention of calling up any further sum. 10,000 preference shares of £5 each, at a premium of 5s. per share, payable 15s. per share on application; £1 10s. on allotment; £1 10s. on February 1st, 1890, and £1 10s. on March 1st. 400 first mortgage debentures of £100 each, at a premium of £2 per debenture, payable £12 per debenture on application; £20 on allotment; £20 on February 1st, and £50 March 1st, 1890, with a right to anticipate payments of instalments. The above shares and debentures will be identical in all respects with those already issued, and will be entitled to the same advantages, including the benefit of the dividend guarantee fund. The premiums received from the present issue will be carried to a reserve fund. The *Investors' Guardian* commenting on this issue says :—"Now it will be remembered that in July last, this company invited subscriptions for £200,000 ordinary shares, £150,000 preference shares, and £100,000 debentures. But instead of this £450,000 being obtained, only £310,000 was taken up, viz., 30,000 ordinary shares, 20,000 preference shares, and 600 debentures. Under these circumstances, we really cannot see why the public should be asked to pay a premium on these shares, and we think they would be most unwise to do so. We are full believers in the development of electricity, but for the present we feel assured that the £310,000 already subscribed should be ample for all legitimate requirements of a business such as that carried on by Messrs. Woodhouse and Rawson United."

The South of England Telephone Company, Limited.—At their meeting, on Friday last, the directors declared a dividend of 6 per cent. per annum, on the preference shares, for the half-year ending 31st October, 1889.

Crompton and Company, Limited.—This company is proposing to issue 500 5 per cent. mortgage debentures of £50 each at par, *i.e.*, £50 per bond. We are glad to see that the company foreshadows for its next balance sheet satisfactory profits.

The Eastern and South African Telegraph Company notify that on the 15th inst., at the offices, 50, Old Broad Street, 283 1st mortgage debentures of £100 each will be drawn for payment on the 1st of January.

Swan United Electric Light Company.—The directors have decided to recommend a dividend of 6 per cent. for the year.

TRAFFIC RECEIPTS.

The Brazilian Submarine Telegraph Company, Limited. The receipts for the week ending November 1st, 1889, amounted to £4,[illegible].

The Cuba Submarine Telegraph Company, Limited. The estimated traffic receipts for the month of October were £2,900 as compared with £3,316 in the corresponding month of last year. The receipts for the month of July, estimated at £3,000, realised £3,063.

The Direct Spanish Telegraph Company, Limited. The estimated receipts for the month of October were £2,625, against £2,210 in the corresponding period of last year.

The Great Northern Telegraph Company, Limited. The receipts for the month of October amounted to £36,000.

The West Coast of America Telegraph Company, Limited. The gross earnings for the month of October were £7,725.

The West India and Panama Telegraph Company, Limited. The estimated receipts for the half-month ended the 31st October are £2,717, as compared with £2,767 in the corresponding period of 1888.

The Western and Brazilian Telegraph Company, Limited. The traffic receipts for the week ending November 1st, 1889, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company Limited, were £3,112.

THE BRITISH ASSOCIATION.

ON TIME-LAG IN THE MAGNETISATION OF IRON.

By J. A. Ewing, B.Sc., F.R.S., Professor of Engineering in University College, Dundee. Royal Society paper, of which an abstract was read September 13th, 1889.

When any change is made to take place in the magnetic force acting on a piece of soft (annealed) iron, a considerable time elapses before the resulting change in the magnetism of the piece is complete. The sluggishness which soft iron exhibits in assuming its full magnetism when a magnetic force is imposed upon it was referred to as follows in the account which I wrote, some years ago, of experiments on the magnetic qualities of iron :—*

"Some evidence was given that, in addition to much static hysteresis, there is a small amount of viscous lagging in the changes of magnetism which follow changes of magnetising force. I repeatedly observed that when the magnetising current was applied to long wires of soft iron, either gradually or with more or less suddenness, there was a distinct creeping up of the magnetometer deflection after the current had attained a steady value, as measured by the deflection of the galvanometer through which it passed. This action was sometimes so considerable as to oblige me to wait for some minutes before taking the magnetometer reading."

In his paper "On the Behaviour of Iron and Steel under the Operation of Feeble Magnetic Forces,"† Lord Rayleigh has remarked on the same phenomenon in soft iron. In his experiments the relation of the magnetic force to the resulting magnetisation of the specimen was studied by means of a magnetometer furnished with a "compensating coil," through which the magnetising current passed, and which was so placed that its action on the needle of the magnetometer balanced the action of the iron, giving no deflection. When very feeble magnetic forces were applied to hard iron or to steel, he found that a perfect balance might be obtained by adjusting the position of the compensating coil, and so established the fact that the susceptibility to small magnetic forces, or to small changes of force, is a definite quantity, which is independent of the amount of the small change of force. He observes that with hard iron and steel the compensating coil might be set so that neither at the moment of closing the circuit of the magnetising current nor afterwards was there any deflection of the magnetometer, which means that (so far as the magnetometer can decide) the metal assumes its magnetic state instantaneously. He goes on to say that soft iron shows much more complicated effects : "When the coil was so placed as to reduce as much as possible the instantaneous effect, there ensued a drift of the magnetometer needle . . . . in such a direction as to indicate a continued increase of magnetisation. Precisely opposite effects followed the withdrawal of the magnetising force. The settling down of the iron into a new magnetic state is thus shown to be far more instantaneous. On account of the complication caused by the free swings of the needle, good observations on the drift could not be obtained with this apparatus, but it was evident that whilst most of the anomalous action was over in 3 or 4 seconds, the final magnetic state was not attained until after about 15 or 20 seconds." Lord Rayleigh then cites my observation, quoted above.

In the following experiments Lord Rayleigh's method of the compensating coil has been made use of for the purpose of examining in some detail this "drift," or "creeping," or quasi-viscous change of magnetism which follows any change in the magnetic force acting on soft iron.

The magnetometer was a light Thomson mirror directed by the horizontal component of the earth's field, and having a free period of double swing amounting to nearly 1¼ seconds. The specimen of iron used in the greater number of the experiments was a straight piece of thick wire 0·404 cm. in diameter and 39·6 cm. long, over which was slipped a tube with a magnetising solenoid wound upon it. The wire was set in a vertical position, magnetically west of the magnetometer, with its top end on a level with the mirror, and generally 6 cm. distant from it. The compensating coil was wound on a wooden frame, which could be moved along a "geometric slide" towards or from the magnetometer in the east-west line through the mirror, for the purpose of balancing the magnetic effect of the iron. In some of the experiments another compensating coil was used to balance the effect on the magnetometer of the magnetising solenoid, but generally the simpler plan was followed of including the effect of the solenoid in the determination of the compensating coil's action on the magnetometer.

To prevent the vertical component of the earth's field from acting on the iron, a second magnetising solenoid was wound over the first, and a constant current of the proper strength to neutralise the earth's field was maintained in it without interruption. The main magnetising current was regulated by having in its circuit a box of resistance coils, and also the liquid slide described in my former paper.‡ This allowed the magnetic force to be changed either suddenly or gradually, and the slide also allowed the method of demagnetising by numerous reversals of a continuously diminishing magnetic force to be resorted to whenever it was desired to reduce the iron to a magnetically neutral state.

To soften the wire it was heated to redness by being slowly drawn through a Bunsen flame. After it was put in place the method of reversals was applied to extract a small amount of magnetism which it had acquired in being handled. In the experiments which I shall first describe the effects of very feeble magnetic force were examined by making and breaking the circuit of the magnetising solenoid while the current was adjusted to produce a force of less than 0·1 C.G.S. It was found that the *immediate* effect of each make and break could be balanced very exactly by adjusting the position of the compensating coil, and so long as the magnetising force was considerably less than 0·1 C.G.S. the distance at which the coil had to be set to give this balance was as nearly as possible independent of the value of the force, and was the same for "break" as for "make." The position of the coil was adjusted so that at the instant when the magnetising current was set up by pressing down a contact key there was no sudden deflection of the magnetometer mirror to either side. When the compensation was right the spot of light simply began to drift slowly towards the side corresponding to increase of magnetism; when there was over-compensation the spot of light gave a quiver to the opposite side before beginning to drift, and the position of the coil was adjusted by drawing it back little by little until the quiver, on pressing down the key, disappeared. The amount of magnetism that was balanced was afterwards measured by removing the iron, but leaving the magnetising solenoid and the compensating coil in place, and observing the deflection of the magnetometer when the same current was passed through the empty solenoid and the compensating coil. This determined the immediate magnetic effect of the magnetising current on the iron, and the subsequent creeping up of the magnetism was of course determined by observing the drifting of the magnetomer needle which had ensued after applying the current while the iron was in its place.

In the following experiment a current of 21 on the arbitrary galvanometer scale (equivalent in this case to a magnetising force of 0·044 C.G.S.) was made, after the wire had been completely demagnetised, and after the compensating coil had been adjusted to balance the immediate effect. Magnetometer readings were taken 5 seconds and 60 seconds after "make"; and at 60 seconds the current was broken, and magnetometer readings were taken 5 seconds and 60 seconds after "break." The immediate effect (balanced by the compensating coil) was equivalent to 25 divisions of the magnetometer scale.

Time after "make."	Magnetometer.	Time after "break."	Magnetometer.
0	0	0	13
5″	8	5″	5
60″	13	60″	0

Adding to these the equivalent of the compensating coil, we see that just after the immediate magnetising force was suddenly applied, the value of the magnetism was 25, which increased after 5 seconds to 33, and after 1 minute to 38; and that when the magnetising force was suddenly withdrawn there was at first a residual magnetism of 13, which fell to 5 in 5 seconds, and disappeared altogether in less than 1 minute.

Next a current 41 (producing a magnetising force of 0·084 C.G.S.) was made and broken in the same way. The compensating coil scarcely required to be moved from its former position, and its equivalent on the magnetometer was now 48. The column headed "total" gives the sum of the magnetometer reading, and the part balanced by the compensating coil.

Time after "make."	Magnetometer.		Time after "break."	Magnetometer.
	Observed.	Total.		
0	0	48	0	31
5″	20	68	5″	13
60″	31	79	60″	4

Here, out of the whole original residue of 31, a small part refused to disappear after the lapse of a minute, and it is probable that with this magnetising force some of the residual magnetism is permanent.

The above results are shown in fig. 1, where the arrows indicate the sequence of magnetic changes. One scale division of the magnetometer is here equivalent to 0·0177 C.G.S. units of $\mathfrak{I}$ (intensity of magnetism). The magnetic force due to the solenoid may be taken as approximately equal to the whole magnetic force (although the rod was barely 100 diameters long, this length should be sufficient to approximate to endlessness when one is dealing with very low values of magnetic susceptibility). On this assumption, one scale division of the galvanometer is equivalent to 0·0021 of $\mathfrak{H}$; the initial instantaneous susceptibility, that is, the gradient $d\,\mathfrak{I}/d\,\mathfrak{H}$, is 9·9, and the initial instantaneous permeability ($d\,\mathfrak{B}/d\,\mathfrak{H}$) is 125. This value has been confirmed by a number of independent observations made with the same piece of annealed wire, and with another piece cut from the same hank and also annealed. Taking the magnetism acquired after one minute, the initial susceptibility as regards that is about 15.

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* "Exp. Researches in Magnetism," *Phil. Trans.*, 1885, p. 569, sec. 52.

† *Phil. Mag.*, March, 1887, p. 230.

‡ *Loc. cit.*, sec. 18, p. 537.

Precisely similar results have been obtained by reversing feeble magnetic forces. So long as the forces are very small, the compensation for "reverse" is the same as for "make" and for "break," and the creeping of the magnetism in any given time after make, break, or reverse is nearly proportional to the amount of the preceding change of magnetising force.

FIG. 1.

In the following experiments the magnetising force was raised to higher values, at which this proportionality no longer held good As before, the compensating coil was adjusted for each current to balance the effect of "make," the iron being demagnetised by reversals immediately before the "make." When a stronger current was applied, the coil had to be pushed nearer the magnetometer: but up to forces of 0·3 C.G.S. or so, it was practicable to secure an instantaneous balance by doing so. Observations of the drift were taken at 5 and 10 second intervals during one minute.*

TABLE I.

Time after "make."	Current.				
	27	62	110	161	261
	Magnetometer + comp. coil.				
seconds.					
0	47	107	224	395	798
5	65	145	304	525	974
10	72	159	327	560	1071
15	74	165	339	573	1089
20	77	169	344	581	1098
25	79	171	347	586	1104
30	79	173	350	590	1109
40	80	175	354	595	1116
50	80	177	355	598	1120
60	80	177	357	600	1124

These are given on p. 273, the equivalent effect of the compensating coil being added in each case to the actual magnetometer readings.

In fig. 2 curves are drawn to show the relation of the current to (a) the immediate magnetisation; (b) the magnetism after five seconds; and (c) the magnetism after one minute. The gradient of the curve (a) at and near the origin is the same as that of the corresponding curve in fig. 1, when allowance is made for difference of scales. In the present instance one division of current is 0·0013 of $\mathfrak{H}$, and one division of magnetism is 0·008 of $\mathfrak{I}$. The gradient begins to increase very sensibly when $\mathfrak{H}$ exceeds about 0·07.

Some of the results of Table I. are also shown in fig. 3, which gives time curves of the growth of magnetism for the first two stages (currents 27 and 62). Similar curves for the other stages may readily be constructed from the table. It should be noticed that the time rate of creeping is by no means excessively great in the first instants after contact is made; it is on this fact indeed that the practicability of the method depends.

Similar differences between the immediate and ultimate increments of magnetism present themselves when the magnetising force is increased step by step. In the following experiment the compensating coil was set so as to balance the immediate effect of a feeble magnetising current. Then such a current was applied, and the creeping up of the magnetism during one minute was observed. At the end of the minute the current was increased by a small step, and it was found that the compensation was still correct, or very nearly so; in other words, that the immediate effect of this small increase of magnetising force bore the same, or very nearly the same proportion to the increment of force as at the beginning of the process of magnetisation. The creep up of magnetism was again observed during a minute; then another small step up of the current was made, and so on. The compensation remained nearly correct for a number of steps, but as the process was continued up the curve of magnetisation, it became apparent that the immediate effect was *increasing*; in other words, that there was under-compensation, and that the compensating coil would have to be moved a little forward if an exact balance was to be maintained. The results of this experiment are given below (Table II.), and are exhibited in fig. 4. The magnetising current was increased from one to another of the successive values shown in the table at intervals of one minute in each case, by moderately quick movements of the sliding block in the liquid rheostat. The changes of magnetic force were therefore not quite sudden; each of them took perhaps a quarter of a second to complete.

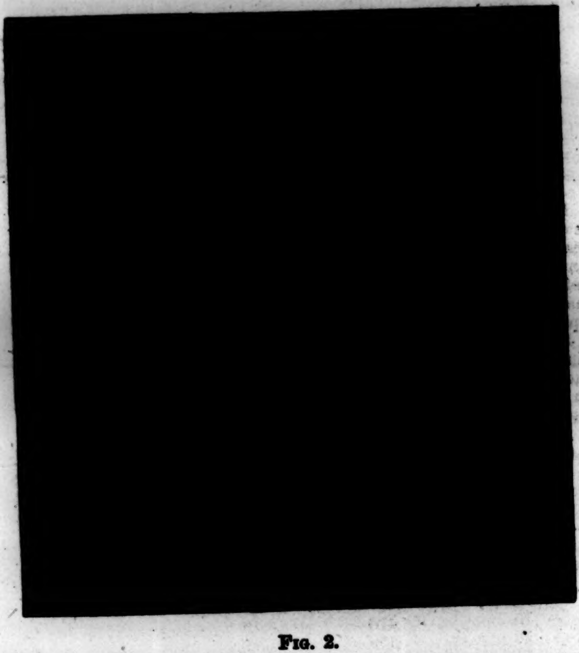

FIG. 2.

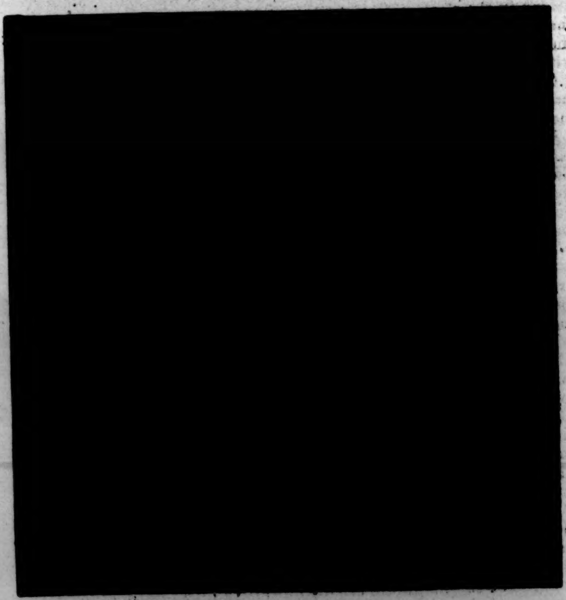

FIG. 3.

The step of 23 was too large to have its immediate effect balanced by the compensating coil in the position in which the coil was set. The magnetic effect of such a large step is conjecturally shown by the broken line marked (?) in fig. 4. It will be noticed that the points reached after one minute at each step lie well on a continuous curve, which is shown by a dotted line in the figure.

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* To make the drift large the top of the wire was this time only 4 cm. from the magnetometer.

TABLE II.

Magnetising Current.		Immediate magnetic effect of step.	Additional increase of magnetism in 1 minute.	Total magnetism (after 1 minute).
Step.	Total.			
30	30	63	36	99
13	43	27	23	149
14	55	26	22	197
12	67	25	35	257
23	90	(49 +)	(75 –)	381
17	107	36	53	470
5	112	10	22	502
10	122	21	33	556

In Table II. and fig. 4 one scale division of magnetising current is equivalent to 0·00862 C.G.S. units of magnetising force, and one scale division of the magnetometer is equivalent to 0·0177 C.G.S. units of $\mathfrak{I}$. The immediate value of $d\,\mathfrak{I}/d\,\mathfrak{H}$ is about 10, as before, and this applies approximately throughout the range of magnetism dealt with here, with a slight increase towards the upper end of the range.

Higher up in the curve of magnetisation, however, the immediate effect of a small quick increment of magnetic force is greater, though then (owing to the greater steepness of the curve, $\mathfrak{I}$ and $\mathfrak{H}$) it bears a smaller proportion to the ultimate effect. This is well shown in the following experiment (Table III. and fig. 5).

TABLE III.

Magnetising current.		Magnetising effect.	
Step.	Total.	Immediate.	Additional in 1 minute.
...	461	...	...
15	476	19	61
13	489	17	55
11	500	14	50
15	515	19	69
32	547	(41 +)	(142 –)

Here the last step was too large for perfect compensation. One scale division of current corresponds to 0·0021 C.G.S. units of magnetising force, and one scale division of the magnetometer corresponds to 0·022 of $\mathfrak{I}$. The immediate susceptibility to small increments of force, $d\,\mathfrak{I}/d\,\mathfrak{H}$, is now about 13. The magnetic viscosity is now so great that this immediate effect is less than one-fourth of the whole change which the magnetisation has suffered by the time 1 minute has elapsed.

To show clearly the region in the curve of magnetisation at which the experiment of Table III. and fig. 5 was made, a curve is drawn in fig. 6, showing, as the result of a separate experiment, the relation in absolute measure of the intensity of magnetism to the magnetising force produced by the solenoid. The region dealt with in Table III. is at the place marked Q ($\mathfrak{H}$ = about 40 C.G.S.), and the dotted line drawn there shows the immediate value of $d\,\mathfrak{I}/d\,\mathfrak{H}$ after a 1-minute pause. The dotted line, P, shows the corresponding initial gradient, or immediate value of $d\,\mathfrak{I}/d\,\mathfrak{H}$, when there is no previous magnetisation.

Another step-by-step experiment of the same kind, made at a place higher up, where the magnetising force of the solenoid was about 4 C.G.S. and $\mathfrak{I}$ about 320, gave again about 13 for the immediate effect ($d\,\mathfrak{I}/d\,\mathfrak{H}$); and this was followed by a creeping to the extent of six or seven times the immediate effect.

The immediate magnetic effect of a small step is substantially the same whether the step is made quite suddenly by short-circuiting a resistance coil in the circuit of the magnetising solenoid, or comparatively gradually by means of the liquid slide, so that the process occupies a sensible fraction of a second, or even as much as a whole second.

However small the step is it appears to be followed by a creeping up of magnetism. I have been able to discover nothing which would correspond with the limit of perfect elasticity in straining a solid (if there be any true limit of elasticity), either in the initial part of the process of magnetisation, or after the prolonged application of a constant magnetising force.

But the prolonged application of a constant magnetising force produces an effect which is a most interesting analogue of one effect of prolonged loading in a stretched wire. It is well known that when a load (sufficiently great to produce permanent set) is applied to a stretched iron wire, there ensues, with the lapse of time, not only a certain amount of supplementary viscous extension (the analogue of the magnetic creep) but also a quasi-hardening of the metal which becomes manifest when an addition is made to the load.* One effect of this is that the wire responds with great sluggishness to the additional load, and this sluggishness is greater the longer has been the preceding interval during which the load has been maintained constant. To test whether, in like manner, the prolonged application of a constant magnetising force would produce what may be called magnetic hardening, I have made comparative observations of the time rate of change of magnetism when a definite small increment of force is applied, the preceding force having been kept constant (*a*) for a short time and (*b*) for a long time. The result is to show that the process of magnetic creeping after a small step is much slower when the preceding force has been in action for a long time than when it has been in action for only a short time.

The following experiment illustrates this well. After raising the magnetising force to between 2 and 3 C.G.S. units, the compensating coil was adjusted to balance the immediate effect of a small increase of force, this increase being brought about by short-circuiting 1 ohm (out of many ohms) in the magnetising circuit. When the compensation had been adjusted, the iron was demagnetised by reversals, and the magnetising force was again gradually applied. When it reached the value of 2·54 C.G.S., a pause was made for 3 minutes, during which time this magnetising force of 2·54 remained constant. The resistance in the circuit of the magnetising current was then suddenly reduced by 1 ohm, which had the effect of raising the force to 2·60. The compensating coil prevented this step-up of magnetising force from having any instantaneous effect on the magnetometer; but creeping, of course, began at once, and the time-rate of creeping was observed during 10 minutes. Then the magnetising current was kept constant for 50 minutes more, making 1 hour in all, and a second step-up of magnetising force was effected by removing another ohm of resistance: the second step was very nearly equal to the first, and raised the force to 2·66 C.G.S. The time-rate of creeping which followed it was also observed during 10 minutes. The results are shown in fig. 7, where the curve A shows the growth of magnetism during 10 minutes when the step had been preceded by a 3-minute interval of constant force, and the curve B shows the growth of magnetism when a sensibly equal step was made, which had been preceded by

FIG. 4.

FIG. 5.

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* *Cf. Roy. Soc. Proc.*, No. 205, 1880, or *Encycl. Brit.*, art. "Strength of Materials."

a 1-hour interval of constant force. The times are in each case reckoned from the instant at which the step was made, and the increment of magnetism is in each case reckoned from the value reached just before the step was made. The immediate effect of each step (balanced by the coil) was equivalent to 51 scale divisions of the magnetometer. The creeping up in 10 minutes was equal to no less than 531 scale divisions in the case of curve A, as against 320 in curve B. At the place marked with an asterisk in curve A, it happened that the laboratory door was slammed, which shook the wire very perceptibly and caused a comparatively sudden increase of magnetism (indicated by the dotted part of the curve), after which the time-rate of creeping became specially slow for 1 or 2 minutes; finally, however, the rate appeared to recover from this disturbance. The curves, *a* and *b*, of fig. 7 are the first parts of A and B drawn to a ten-fold coarser scale of times.

FIG. 6.

FIG. 7.

In confirmation of the above, another experiment was made in which the magnetic force was increased by three successive small and very nearly equal steps. The first step was made after 5 minutes of constant force, the second after 1 hour of constant force, and the third again after 5 minutes of constant force. Time-curves of the growth of magnetism were drawn in all three cases. The first and third curves were not far from coincident; but the second curve lay very much below them, as B lies below A.

In the experiments to which figs. 4, 5, and 7 relate, the increment of magnetic force whose effects were measured was preceded by increasing magnetic forces; in other words, it was a step-up from a point on the *up* curve of magnetisation. I have also examined the effect of a small *step-down* from a point on the up curve—that is to say, a small decrement of previously increasing force—and find, as might perhaps be anticipated from what we knew about static hysteresis, that the immediate effect ($d\,\mathfrak{I}/d\,\mathfrak{H}$) of a step-down is decidedly less than the immediate effect of a step-up. When the compensating coil had been adjusted to balance the first effect of a step-up, it was found to give over-compensation for a step-down.

Another process has been examined, namely, the alternation of a step-up with step-down, many times repeated. After the magnetising current had been raised to a certain value, it was periodically altered through a definite narrow range by alternately putting in and pulling out the short-circuit plug of a small resistance coil in the main circuit, or by making and breaking a feeble circuit in a second solenoid wound over the first. It was only when this process had been repeated many times that the magnetic effects of the small changes of $\mathfrak{H}$ became approximately cyclic; the early cycles were associated with a progressive rise in the intensity of magnetism. But when a nearly cyclic state was reached, the compensating coil could be adjusted to balance the immediate effects of $+\,\delta\,\mathfrak{H}$ or $-\,\delta\,\mathfrak{H}$, and the same adjustment, of course, served to balance either.

Tested in this way, the gradient $d\,\mathfrak{I}/d\,\mathfrak{H}$ (for the immediate effect of $\delta\,\mathfrak{H}$ after many small + and − steps), has, of course, a lower value than the gradient which is found when $\mathfrak{H}$ is first raised to $\mathfrak{H} + \delta\,\mathfrak{H}$. The latter, as we have seen, is greater when the magnetisation is moderately strong than when there is little or none. The former is nearly constant throughout a wide range of $\mathfrak{I}$; its value is approximately the same as at the initial part of the magnetisation curve—namely, 10—until the region of saturation is approached, when it becomes distinctly less.*

The periodic changes of magnetism which are brought about by successive small increments and decrements of $\mathfrak{H}$ exhibit a lagging and creeping up and down precisely similar to that which has been illustrated in fig. 1. That figure may serve to show in a general way the relation of the change of $\mathfrak{I}$ to the change of $\mathfrak{H}$, when at any place in the curve a very small increment $\delta\,\mathfrak{H}$ has been applied and removed often enough to establish a cyclic *régime*. I have not made any full examination of the variation which under these conditions the gradient $d\,\mathfrak{I}/d\,\mathfrak{H}$ suffers when the magnetism on which the small cycle if superposed is gradually pushed up towards saturation, nor of the proportion which the subsequent creeping up or down bears to that part of the change of $\mathfrak{I}$ which occurs immediately on the application or removal of $\delta\,\mathfrak{H}$. The creeping which follows each repeated application and removal of $\delta\,\mathfrak{H}$ is certainly much reduced when the iron approaches saturation; but the immediate effect is also reduced, and so far as may be judged by rather rough determinations, it appears that the proportion of creeping to immediate effect is much the same with high as with low magnetisation.

One may refer, in this connection, to the energy which is dissipated through hysteresis, in performing a small cycle by alternately applying and removing a very small force $\delta\,\mathfrak{H}$. The action is the same in kind whether there is or is not additional magnetisation. The energy dissipated in each cycle is $-\int \mathfrak{I}\,d\,\mathfrak{H}$, and vanishes when the increment and decrement of $\mathfrak{I}$ go on *pari passu* with the increment and decrement of $\mathfrak{H}$.

Consider now fig. 1. When the repeated cyclic changes of $\mathfrak{H}$ are indefinitely rapid and go on without pause, so that creeping has not time to occur, a single straight (or sensibly straight) line such as O, A, represents the relation of the change of magnetism to the (very small) change of magnetising force, during both increment and decrement. The rapidity of the action prevents any loop from being formed, and there is consequently no sensible dissipation of energy through hysteresis. This state of things is perhaps nearly realised in the case of a vibrating telephone diaphragm, or, in regard to circumferential magnetisation, by an iron conducting wire in a telephone circuit. Again, let the cycle be performed indefinitely slowly. In that case the magnetism, at every stage of the cycle, creeps up or down to a steady value. A sensibly straight line, such as O, B, represents the relation of $\mathfrak{I}$ to $\mathfrak{H}$ during both increment and decrement; and there is again no dissipation of energy. But with any frequency of alternation lying between these extremes of infinitely fast and infinitely slow, a loop will be formed, since the creeping will take effect most considerably at and near the ends of the range (the time rate of change of $\mathfrak{H}$ being least there), and there will be dissipation of energy. When the limits and mode of variation of $\mathfrak{H}$ are specified, there must be some particular frequency which will make the energy dissipated per cycle a maximum.

The phenomena described in the paper have been reproduced in several specimens of annealed iron wire, of course with quantitative differences. As to the amount of magnetic creeping much depends on the annealing of the specimen. Another piece of iron wire cut from the same bundle as the piece with which these experiments were made, and annealed at another time, showed almost exactly the same susceptibility to magnetism as the first piece, so far as immediate effect went; but in it the subsequent creeping up was decidedly less (in the proportion of about 4 to 5).

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* *Cf.* Lord Rayleigh, *loc. cit.*, on the approximate constancy of the *static* gradient $d\,\mathfrak{I}/d\,\mathfrak{H}$.

When the iron is hardened by mechanical strain the phenomena of creeping vanish almost completely. A specimen from the same bundle was annealed, and showed much creeping. It was then put in the testing machine and pulled until it took a set of 1 or 2 mm. in a length of 40 cm. or so. It was then examined magnetically as before, and scarcely a trace of creeping could be observed when a feeble magnetising force was applied. When the compensating coil was properly adjusted the making or breaking of the magnetising current caused no more than a slight momentary quiver of the magnetometer needle, followed by no measurable drifting, although the whole magnetic effect (compensated by the coil) was equivalent to a hundred or more scale divisions. When a magnetising force of as much as 0·6 C.G.S. units was suddenly applied, the amount of creeping, if there was any, was certainly less than 1 per cent. of the immediate effect. With values of $\mathfrak{H}$ higher than this it became possible to detect creeping with certainty. The following notes relate to this wire:—

Magnetising force suddenly applied. (C.G.S.)	Immediate value of $\mathfrak{I}$ (C.G.S.).
0·75 ...	4·49
1·28 ...	8·42, crept in 1 min. to 8·58.
2·40 ...	25·5 „ „ „ 26·4.

These forces were in each case applied to this wire in a neutral state. Another trial of the same, with feebler forces, gave 5·3 as the value of $d\,\mathfrak{I}/d\,\mathfrak{H}$ for the immediate effect of a very small force, applied when the iron was demagnetised. The same quantity in the annealed specimen was, as has been said, about 10. In fig. 6 the relation of $\mathfrak{I}$ (immediate) to $\mathfrak{H}$ as stated above, is represented by the curve, O, R; the creeping up at the last point is R, S.

In speaking of soft iron it has been shown that the effects of creeping are most marked when a small addition, $\delta\,\mathfrak{H}$, is made to a previously increasing force, $\mathfrak{H}$. In instances quoted above, the creeping up in 1 min. has under those conditions been many times greater than the immediate effect of $\delta\,\mathfrak{H}$.

By way of putting the specimen of hardened iron to the same test, I have applied a magnetic force of 1·46 and raised it by a small step to 1·49. The immediate effect of this step (which was balanced by the compensating coil) was equivalent to 22 scale divisions of the magnetometer, and this was followed during one minute by a creeping equal to six scale divisions. In itself this creeping is considerable, but compared with the corresponding creeping in soft iron it is extremely small.

Pieces of steel (containing a good deal of carbon) have also been examined, with the result that whether the steel be annealed or in its commercial temper, the phenomenon of creeping is even less visible than in hardened iron. With annealed steel, a force which produced an immediate (compensated) magnetic effect equal to 124 scale divisions caused barely a single scale division of creeping. With a stronger current, giving an immediate magnetism of 340, the subsequent creeping was 3. In steel and in hard iron the creeping seemed to be completed in a few seconds after the institution of the magnetising current. The steel specimen, like the iron, had a diameter of rather more than 4 mm. Its susceptibility (annealed) was considerably less than that of the iron in the hard state.

It is scarcely necessary to observe that the protracted and extensive creeping or magnetic "nachwirkung" in soft iron which these experiments illustrate cannot be ascribed to the subsidence of the circumferential currents which are generated by the imposition of logitudinal magnetic force. The creeping is equally conspicuous whether the magnetic force is suddenly or gradually imposed. Lord Rayleigh has shown that circumferential currents started and left to themselves will subside to e^{-1} of their initial magnitude in the time.

$$\tau = \frac{4\,\pi\,\mu\,a^2}{(2{\cdot}404)^2\,\rho},$$

where a is the radius of the cylinder, μ its permeability, and ρ its specific resistance.* In the present instance, taking the case of the annealed iron rod, $a = 0{\cdot}202$, $\mu = 125$, $\rho = 9{,}827$ (Everett), and τ is less than $\frac{1}{1000}$th of a second. The subsidence would be practically complete in a small fraction of a second; but the creeping persists during many seconds, and even minutes, with no excessive change of rate. Again, comparing soft iron with hard iron, in which μ is less and ρ is greater, the values of τ will differ, but not by any means so much as to correspond with the very wide difference in magnetic lag.

In view of this it is puzzling to find that the diameter of the rod experimented upon has a most important influence on the magnetic lag.

In testing various samples of soft iron wire, most of which were of less diameter than the piece used in the above experiments, I noticed that the phenomena of creeping were less marked in the smaller rods. I then tried a bundle of nine very soft annealed iron wires, which were bound together with fine copper wire, and formed a core of about the same length and aggregate diameter as that of the solid rod formerly used. With this bundle there was some creeping, but very little in comparison with what was observed in the solid rod, as the following notes show:—

BUNDLE OF NINE SOFT IRON WIRES.

Magnetic force $\mathfrak{H}$ suddenly applied (C.G.S.)	Magneto Deflections.		
	Immediate (balanced by compensating coil.)	Subsequent creeping in 1 min.	Total in 1 min.
0·052	17	2	19
0·147	52	9	61

Finally, another bundle was built up, consisting of a much larger number of fine annealed iron wires. With this the creeping was almost insensible.

It may be that the comparative absence of magnetic creeping, or "nachwirkung," in these last experiments is to be ascribed to the quickness with which the process of creeping completes itself in a finely divided mass of iron; in other words, that the process is practically completed in a time much shorter than the period of the magnetometer needle. The marked difference in effect between a solid core (a single thick wire) of soft iron and a laminated core (a bundle of fine wires) of the same material, suggests that in the former much more than in the latter the process of creeping is retarded by the eddy currents which are set up by those molecular movements in which the process itself consists.

[July 11th.—In seeking an explanation of the difference in behaviour it may be worth while to bear in mind that there is probably a considerable difference in molecular structure between a solid core and a laminated core of iron. If we accept the view that the magnetically neutral state is due to the molecular magnets forming closed rings, these rings will for the most part be closed within the limits of the separate constituent pieces of the laminated core, whereas in the solid core they may be much larger, their dimensions being limited only by those of the core itself.]

I have received very valuable help in these experiments from two students, Mr. David Low and Mr. William Frew, who have prosecuted a troublesome research with much patience and zeal.

A NEW THERMOMETRIC SCALE.

By GEORGE FORBES and WILLIAM HENRY PREECE.

THE recent Electrical Congress at Paris has adopted the *Joule* as the unit of work, and the *Watt* as the unit of power. The following definitions were unanimously accepted:—"The practical unit of work is the *Joule*. It is equal to 10^7 C.G.S. units of work. It is the energy expended during one second by an ampère in an ohm."

"The practical unit of power is the *Watt*. It is equal to 10^7 C.G.S. units of power. The Watt is equal to a Joule per second."

The *Therm*, as the unit of heat which was proposed by the British Association Committee at Bath last year, did not commend itself to the French members. They preferred, for the present, to retain the term *Calorie*, notwithstanding the confusion from there being two units of that name. It is said there is only one Calorie in the C.G.S. centrigrade system.

But the question arose—is there any need for either the Therm or the Calorie? Cannot the Joule be made a thermal unit also, for the latter is only a unit of work. The heat generated in T seconds by C ampères flowing through R ohms (or driven by E volts) is $C^2 R T = E C T$ Joules. If we take the mechanical equivalent of heat as approximately 42,140,000 ergs, or 4·2 Joules, it means that 4·2 Joules will raise one gramme of pure water at 4° C. one degree.

We have here the scientific mode of forming a C.G.S. thermometric scale. If we take the fiducial points of freezing and boiling points of pure water at normal pressure on a column of mercury as usual, and divide the distance into 420 divisions, then each division is a true C.G.S. unit of temperature, and will be passed by the expenditure of one Joule per gramme of work.

Instead of employing degrees of temperature we can use these units of temperature, and we can replace the angular symbol $x°$ by t or θ. Thus, to raise one gramme of water from freezing point to boiling point requires 420 Joules, or to raise it to boiling point from 62 units it requires 358 Joules. There would be no necessity for coefficients, and calculations would be simplified. Degrees centigrade would be simply converted into these units by multiplying by 4·2 and degrees Fahrenheit by deducting 32°, and multiplying the remainder by 2·33.

An objection to such a scheme has been raised by Prof. Potier, of Paris, and it is that the mechanical equivalent of heat has not yet been determined with sufficient accuracy to justify its adoption as final.

He thinks it wrong by nearly 1 per cent. The principal measurements are:—

Joule (1878)	4·1624
Therm	4·2485
Violle	4·2701
Regnault	4·2877

This ought to be a reason to re-examine the question, and with our existing knowledge of the ohm and ampère we ought to be able to drive the Joule with an exactitude that will satisfy the scientific world.

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* *Brit. Assoc. Report*, 1882, p. 446.

PROCEEDINGS OF SOCIETIES.

Physical Society, November 1st, 1889.

Prof. Reinold, F.R.S., President, in the chair.

The following communications were read:—"On a New Electric-Radiation Meter," by Mr. W. G. Gregory. The meter consists of a long fine platinum wire attached to a delicate magnifying spring of the Ayrton and Perry type, and stretched within a compound tube of glass and brass. At the junction between the wire and spring a small mirror is fixed. When the tube is placed parallel to a Hertz's oscillator in action, the mirror is turned in a direction indicating an extension of the wire. The arrangement is so sensitive that an elongation of $\frac{1}{100000}$ of a mm. can be detected, and when placed at a distance of a metre from the oscillator, the apparent extension is such as would correspond to a change of temperature of 0·008° C. By its aid the author has roughly verified Hertz's statements that at considerable distances the intensity of radiation varies as the inverse distance; but before he can proceed further it is necessary to greatly increase the sensibility of the apparatus; and with a view of obtaining some suggestions in this direction, he exhibited it before the Society.

Prof. Perry asked if the E.M.F. required to produce the observed results had been calculated; he also believed that the sensibility might be increased by using copper instead of platinum, and replacing the spring by a twisted strip.

Mr. Blakesley enquired whether the effect of increasing the capacity of the ends of the wire had been tried.

Mr. Boys said that if the observed effect was due to rise of temperature, he would like to see it measured thermally. He also thought the effect might be due to extension caused by rapid electric oscillations in some such way as the elongation of an iron bar caused by magnetisation.

In answer to this, Prof. S. P. Thompson said the matter had been investigated experimentally, but with negative results.

Prof. Herschel suggested the use of a compound spring, such as are used in Breguet's metallic thermometers.

In reply, Mr. Gregory said he had estimated the E.M.F. by observing that a Leclanché cell through 50 ohms produced about the same result. No improvement in sensitiveness was obtained by using copper wire or by increasing its capacity, and attempts to measure the rise of temperature by an air thermometer had been given up as hopeless.

The President, in thanking the author for his paper, congratulated him on the ingenuity and courage displayed in producing an apparatus to measure such microscopic quantities as are here involved.

"On a Method of Driving Tuning Forks Electrically," by Mr. Gregory. In order to give the impulses about the middle of the stroke, the fork is arranged to make and break the primary circuit of a small transformer, the secondary circuit of which is completed through the electromagnet actuating the fork. The prongs of the fork are magnetised and receive two impulses in each period. Another device was suggested, where the prongs respectively operate contacts which successively charge and discharge a condenser through the coils of the actuating magnet.

Prof. S. P. Thompson said the methods, if perfect, would be of great service, and suggested that a fork so driven be tested optically by comparison with a freely vibrating one. He regarded the mercury contacts used as objectionable, for their capillarity and adhesion would probably cause the impulses to lay behind the appointed epochs.

Prof. M'Leod remarked that Lissajou's figures gave a satisfactory method of testing the constancy of period and could be readily observed without using lenses, and in reference to liquid condensers suggested by the author for his second device, said that platinum plates in sulphuric acid were found to disintegrate when used for this purpose. He thought lead plates would prove suitable.

Prof. Jones, who read a paper on a similar subject in March last, said he now used bowed forks with which to synchronise the speed of the disc there described, and the frequency is determined by causing the disc to complète the circuit of his Morse receiver once each revolution.

"On a Physical Basis for the Theory of Errors," by Mr. C. V. Burton, D.Sc. After pointing out that the law of error for any particular measurement depends on the nature of the conditions governing such measurement, the author considers several simple cases, and deduces their curves of error. A kinematic method of combining two or more independent errors, each following known laws, is then described and applied, and the general formula obtained leads to Laplace's law of error in the case of an infinite number of similar errors. Referring to *most advantageous combinations of measures*, it is shown that the method of least squares is only a particular solution of the general equation, and is derived by assuming the individual errors to conform to Laplace's law. *Subjective errors* are next considered, and in conclusion the author says that "the law of error in a set of observations depends on the nature of each special case, and what may be called the probable law of error is determined by our knowledge of the conditions. The combination of three or more sources of error of comparable importance gives in general a law not seriously differing from that of Laplace, so that the method of least squares will be practically the most advantageous, except where a single source of error with a very different law is predominant above all the rest."

"A Note on the Behaviour of Twisted Strips," by Prof. J. Perry, F.R.S., had been prematurely announced by mistake, and he accordingly gave only a brief outline of the paper. In a previous communication Prof. Ayrton and the author enunciated a working hypothesis in which the strips were imagined to be split up into pairs of filaments, each pair acting as a bifilar suspension. The resulting formula for the rotation produced by a given load did not agree with experiment, and quite recently the author had recognised why the formula was incorrect. The bifilar law they had assumed was only true for small twists, but he now saw another method of treatment by which he hoped to verify the formula derived from experiment before the next meeting.

Prof. Fitzgerald reminded Prof. Perry of a method of attacking the problem suggested by the speaker some time ago, in which each filament was supposed to be wrapped round a smooth cylinder, and said that on working it out the formula was found to be very complicated.

Mr. Trotter thought the pairs of strips might be regarded as twisted ladders, and Mr. Gregory said this suggestion reduced the problem to a series of bifilar suspensions which had already been worked out.

"On Electrifications due to Contact of Gases and Liquids," by Mr. J. Enright. For some time past the author has been studying the electrical phenomena attending solution, by connecting an insulated vessel in which the solution takes place with an electrometer. As a general rule no effect is observed if nothing leaves the vessel, but when gases are produced and allowed to escape the vessel becomes charged with + or − electricity, depending on the nature of the liquid from which the gas passes into the air. As an example, when zinc is placed in hydrochloric acid, the deflection of the electrometer is in one direction whilst the liquid is chiefly acid, but decreases and reverses as more and more zinc chloride is produced. From such observations the author hopes to obtain some information relating to atomic charge. Owing to the lateness of the hour the latter portion of the paper and the discussion on it were postponed until next meeting.

NEW PATENTS—1889.

16648. "An improved electric railway system." M. Wheless and S. E. Wheatley. Dated October 22. (*Complete.*)

16655. "Improvements in electric storage batteries." W. J. Brewer. Dated October 22.

16662. "Improvements in moulds for casting the plates of secondary or storage batteries." W. Shapleigh. Dated October 22. (*Complete.*)

16680. "Improvements in attaching or fastening telpher cables and electric light cables, telegraph wires, telephone wires, and other cables, wires and rods to insulators." E. J. Chambers. Dated October 22.

16710. "Improvements in dynamo-electrical machines." W. T. Goolden and H. W. Ravenshaw. Dated October 22. (*Complete.*)

16721. "Improvements in and relating to dynamo-electric machinery." J. Fraser. Dated October 23.

16748. "Improvements in electrical switches." P. P. Alexander. Dated October 23.

16751. "An improvement in footway kerbs with conduits for electrical conductors." A. Ventris. Dated October 23. (*Complete.*)

16777. "Improvements relating to switches for use in connection with telephonic apparatus." J. G. Brien. Dated October 24.

16790. "Improvements in electric safety-fuses." M. Ruddle. Dated October 24.

16839. "An electric supply meter." J. Perry. Dated October 25.

16847. "Improved system of electric generation and apparatus." H. J. Allison. (Communicated by J. I. Conklin and W. H. Rushforth, United States.) Dated October 25. (*Complete.*)

16879. "Improvements in and connected with electricity meters." C. P. Elieson. Dated October 25.

16880. "Improvements in electric bells." L. W. Winnall. Dated October 25.

16887. "Means for ascertaining the state of the vacuum in incandescent electric lamps." F. H. W. Higgins. Dated October 25.

16890. "Improvements in elements for secondary batteries." E. Frankland, A. H. Hough, and D. G. FitzGerald. Dated October 25.

16917. "Improved winding of armatures of dynamos." J. Farquharson and F. V. Andersen. Dated October 26.

16947. "Improvements in treating and rectifying or ageing alcohol or alcoholic liquors or the like by electricity." A. de Meritens. Dated October 26. (*Complete.*)

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1888.

11354. "New or improved methods of and apparatus for utilising electric energy, and the application thereof to the propulsion of aerial vessels." J. G. Lorrain. Dated August 7. 8d. The invention embraces an electrostatic motor; but, instead of feeding it by a current generated by an electrostatic machine, the inventor feeds it by a current from a source of current electricity, such, for example, as a primary battery. He may raise the current furnished by this source of current electricity to a sufficient electromotive force by means of an induction coil or transformer, the primary coil of which is in circuit with the said source of current electricity and the secondary coil of which may be in circuit with the electrostatic motor. To enable the current in the primary circuit of the transformer to induce a current in the secondary circuit he may interpose in the said primary circuit a device for rendering the current therein an alternating or an undulating or an interrupted one. This device may be actuated either directly or indirectly by the current or by the electrostatic motor, or by an independent motor of any suitable kind. 8 claims.

11898. "Improvements in or relating to apparatus for indicating the strength of current upon an electric circuit." O. B. Shallenberger. (Under International Convention.) Dated January 21. 8d. Relates particularly to that form of indicator in which a Wheatstone bridge or equivalent circuit is so organised that when currents of the character named are caused to traverse it, a counter electromotive force will be developed in one or more of the conductors, which will increase the apparent resistance thereof. This counter-electromotive force will increase and decrease as the applied electromotive force varies. By properly organising the indicating circuits such changes in the distribution of the differences of potential may be secured as to effect the proper operation of the indicating apparatus. 7 claims.

14941. "Improvements in electrical burglar alarms." A. Gauge. Dated October 17. 8d. Relates to a novel construction of electric appliance to be fitted within a centre bead or other necessary part of a window or to some portion of a door frame, or of a shutter frame, so that when the window, door or shutter is opened beyond a given distance, electrical contact would be made and an alarm bell or other sound producer operated. 3 claims.

15206. "Improvements in apparatus for transmitting telegraphic, indicating, or other analogous signals or movements." A. B. Brown. Dated October 23. 8d. Claim:—In apparatus for transmitting telegraphic, indicating, or other analogous signals or movements by means of chains, cords, wires, rods, or similar mechanism, such mechanism being acted on by means of pulleys or equivalent devices and acting on pulleys or equivalent devices, applying springs or weights to act on the receiving parts and place them in exact correspondence with the transmitting parts whenever the latter are moved into or through the middle or other predetermined position, the transmitting parts being provided with a cam or other device which disengages the actuating parts so as to allow of the correcting adjustment, all substantially as described.

15433. "Improvements in plates or electrodes for secondary batteries." T. J. Handford. (Communicated from abroad by L. Duncan, America.) Dated October 26. 8d. Consists mainly in providing the supporting and conducting base plate or core of the electrode with a protecting covering which is impervious to the acid solution used as an electrolyte in the battery and outside of which the active material is placed. This protecting covering consists of a hard dense coating of an oxide of lead. 2 claims.

15501. "Improvements in the manufacture of electric bell push fittings." C. J. Harcourt. Dated October 30. 6d. Consists in so arranging the construction of electric bell push fittings that two materials may be used instead of only one, in such a way as to facilitate manufacture and ornamentation. The frame, which carries the non-conductor carrying the metallic contact pieces before mentioned, is made of metal, but the front portion is left open, and, by means of a shoulder or "set off" made in the interior of such metallic frame, a ledge or seat is provided, against which is rested or placed a disc or other shaped body of some non-conducting material, which is secured in its position by the metal surrounding it being pressed tightly over the circumferential edge, and which is formed with a central hole to receive the ordinary push piece. 2 claims.

15550. "Improvements in apparatus for telephonic communication." J. Sack. Dated October 29. 8d. Relates to apparatus employed in intermediate stations, and has for its principal object to automatically connect again the branches of a telephone conduit which had to be separated during a conversation. 4 claims.

15626. "Improvements in electric batteries." P. Schoop. Dated October 30. 8d. Has for its object to increase the useful effect and the duration or "life" of the elements of electric batteries, in particular of secondary or storage batteries or accumulators, and has reference to an improved method or means for carrying and holding the electrodes, and for coupling or connecting them. The improvements in secondary or storage batteries relate more particularly to the arrangement of the positive and negative plates and to the construction of the cell. 3 claims.

15713. "An improved connector for electrical conducting wires." Sir David Salomons and H. Faraday. Dated October 31. 8d. Has for its object to provide a connector whereof all the parts (except the safety fuse) are thoroughly infusible, and are so disposed that accidental short circuiting is impossible; the parts are readily accessible without the use of tools; whilst, no screws or nuts being visible, the connector cannot readily be tampered with, and there is nothing to tempt meddlesome persons to take it to pieces; lastly, the parts that act as insulators are secured by external means in such a way that they are not liable to be split or injured in fixing them, or broken by any object coming into collision with the fitting. 3 claims.

15877. "Pocket or portable secondary batteries or accumulators." E. Rousseau. Dated November 3. 8d. Relates to the improvement in the construction of pocket accumulators or secondary batteries, for durability, for the lengthened holding of their charges, for perfect insulation of their lead-out terminals, for perfect insulation of their plates—one from the other and each section from its neighbour, for so arranging their terminals and gas vent holes as to guard against the leakage of liquid from the one or the escape of gas from the other; and for so building up the plates so as to secure a large active surface in a small compass, and lightness. 8 claims.

16141. "Electrical contact apparatus worked by passage of a railway train." E. Tyer. Dated November 7. 8d. Claim:—Electrical contact apparatus wherein a loose or perforated piston, being rapidly moved in a cylinder by the depression of a rail on the passage of a train, causes mercury contained in the cylinder and in a cup communicating with it to make or break contact with a wire in the cup, thereby closing or opening an electric circuit, arranged and operating, substantially as and for the purposes set forth.

16212. "Improvements in phonographs or apparatus for recording and reproducing sound, and in phonograms or surfaces for receiving sound records, and in envelopes for such phonograms." G. E. Gouraud. (A communication from abroad by T. Alva Edison, of America.) Dated November 8. 11d. Relates chiefly to a phonogram or phonograph record which can be conveniently transmitted by mail. Such a phonogram consists of a cylinder of paper or other flexible material, provided with a covering of material adapted to be indented by the phonograph recording point, and capable of being collapsed into flat form so as to be readily enclosed in an envelope for mailing. Such a cylinder is made by first wrapping a sheet of paper, or other flexible material, around a cylindrical tapering core provided with a handle, and then (the core being held by the handle) dipping the paper into melted wax, or a mixture of salts of fatty acids, such as oleate of lead and palmitate of magnesium. The wax or other material adheres to the surface of the paper and forms a coating which can be indented by the recording point of the phonograph. The surface of the coating is then turned in a lathe, so as to leave it truly cylindrical. A cylinder of this description can be used without further preparation on a phonograph. For making the cylinder collapsible, the indenting material is scraped off the surface of the paper by means of a suitable tool or machine along two narrow lines directly opposite each other, and extending the whole length of the cylinder. 5 claims.

16339. "Improvements in the generation of rhythmic electric currents." C. Langdon-Davies. Dated November 10. 8d. Claims:—1. The described method of generating rhythmic electric currents by means of vibrating parts so arranged in connection with a coiled iron core and a contact for the current to the coil, that contact is maintained during one half of each vibration, and that contact is interrupted during the other half of each vibration, the periods of transmission and of cessation of impulses being thus equalised. 2. In combination with a free tongue or rate governor vibrating under the influence of a coiled iron core, a subsidiary vibrating tongue of less strength and greater speed, so arranged in connection with the governor and with a contact stop that it is carried by the governor away from the contact during half a vibration of the governor, and that it rests against the contact during half a vibration of the governor, substantially as described.

16905. "Improvements in or relating to electrical locks." G. C. Dymond. (A communication from abroad by P. Schwenke, of Germany.) Dated November 21. 8d. Has for its object a lock for doors and drawers which can be released from a distance by electricity. Electrical contact can be established at a fixed time by means of a clock or by pressure upon a button or push. 3 claims.

1889.

8657. "Improved methods of and appliances for conducting and distributing electric currents." E. B. Bright, F. W. Engelbach and J. Bright. Dated May 24. 8d. The object of this invention is to utilise gas and water mains, or pipes or sewers, or other suitable conduits, by introducing into them electrical conductors suitably insulated and protected when necessary. 3 claims.

10814. "Improvements relating to lanterns for electric lamps, and to posts for supporting the same." R. E. Kern. Dated July 4. 8d. Comprises an improved method or manner of connecting or attaching a lantern for an arc electric lamp to the post or column, so that the said lantern may be readily connected therewith or disconnected therefrom, and whereby the inventor is enabled to form the top or upper portion of the said lantern as well as the lower portion thereof, of opal or similar material. claims.

11075. "Dynamo-electric machines." S. C. C. CURRIE. Dated July 9. 8d. Consists in a new way of winding the armatures of dynamo-electric machines, and of governing such machines, whether they be generators or motors, by throwing one or more commutator brushes or brush circuits into or out of action. 5 claims.

11900. "An improved conduit for electric railways." M. DALLOS. Dated July 26. 6d. Relates to improvements in a conduit for electric railways, in which a sheave is made to operate in conjunction with a wire or rod, and the objects of the invention are to provide a device whereby cars may be propelled by electricity by means of a surface conduit. 2 claims.

12731. "A plate for secondary batteries." W. P. KOOKOGEY. Dated August 13. 8d. Consists in general of the combination of a supporting plate of some solid material which is not destructively acted upon by the acid of the battery, and which has a low difference of potential with lead (such as wood), such plate being pierced with openings into which the active material, or the material intended to be made active, is placed; the two plates being held tightly together. The objects attained by it are, that it lasts very much longer than any plate heretofore known, and more efficiently, owing to its completely avoiding or greatly diminishing the common faults which lead to the destruction of the ordinary plate, such as buckling, scaling, disintegration, reduction of the solid frame of the plate, &c.; and that it is very much lighter and cheaper, owing to the material used and the ease of manufacture. 4 claims.

BETWEEN TWO STOOLS.

THE Edinburgh and Leith Gas Commissioners have adopted a rather peculiar policy. At their last meeting they agreed neither themselves to supply the public with the electric light, nor to allow any other body an opportunity of conferring this benefit upon the community. With rare selfishness they have taken up the mistaken attitude, "Let other towns bear the expense of the experiment of testing the value and success of the electric light; we are content to wait to take advantage of their trouble and outlay." In such a position the Commissioners are bound to fall between two stools. They must either take upon themselves the duty of supplying the electric light to the many applicants for the benefit of such a boon in a large city like Edinburgh, or leave room for others to do so. With so many companies knocking at their door, seeking permission to provide a much desired illuminant, it will not do for the Edinburgh Commissioners to pursue this dog-in-the-manger policy. It is not creditable to the metropolis of Scotland that it should thus seek to stop the hands of time. Edinburgh, like other cities, must keep abreast of the age. Their untenable position cannot be entertained by the Board of Trade, and we trust that this so-called "despot," for which Councillor Cranston has a wholesome fear, will see that Edinburgh is not left out in the cold in the matter of the electric light.

CORRESPONDENCE.

The G. P. O. Engineering Department.

The morning paper from which you copied the paragraph about the engineering force of the Post Office telegraphs is not far out as regards facts. The engineering of the public telegraphs is not conducted by "telegraphists" but by officers of "similar rank and pay"—the only exceptions being the superintending engineers—and their pay is less than that of their predecessors.

The engineering clerks and inspectors have the same pay as telegraphists but longer hours, and either a less rate for overtime or no payment for it at all. Your commendation of the work of the department is very gratifying, but the public would hardly believe that an engineering clerk of some service, to get an increase of 2s. per week and be placed on the next scale, may be sent from, say, London to Belfast, whilst a telegraphist would get the same increase and stay in London. If the said clerk qualify for an inspectorship, after more years of service, he might be sent from Belfast to some distant place in England, Ireland, or Scotland, and so far away that for years his so-called promotion would be a charge to him instead of a benefit, the department, in its generosity, expecting him to bear the whole cost of removal. The same rule applies to clerks, and I know that some (who were picked from the ranks of skilled telegraphists on account of their ability) are too poor to bear the cost of removal when their 2s. a week increase is offered them 300 miles off. It is high time that this branch of the service was better treated and its clerks paid at least as well as the "lowest rank" of clerks in the Civil Service. No department is so badly paid, and none has perhaps been so "pared down" of late.

S. N.

November 2nd, 1889.

[A reference to the Telegraphs Section of the Civil Service Estimates, in which all the salaries are given, does not bear out our correspondent's statements, though no doubt a part of his contention may be correct.—EDS. ELEC. REV.]

Fused Joints.

May I be allowed to introduce to your notice a method of making electrical joints by fusion. I was anxious to construct a somewhat complicated network of conductors in such a manner that the system might (as far as possible) be free from Peltier effects. When solder is used we know that such effects exist. In order to avoid this source of trouble I have used joints made by fusing their ends of copper conductors together by means of the oxyhydrogen blowpipe. As many old joints, on which a current has been acting during the usual hours of house lighting, have now been tested and found as strong as when first made, I venture to suggest the method to some of your readers to whom, perhaps, it may be of interest. It is as follows:—

A V-groove is cut in a piece of dry fire brick, or a piece of hard quick lime, the ends of the wires to be joined are placed side by side in the groove, and then the flame of the blowpipe is brought down upon them; in the case of a joint made in No. 12 wire the ends were fused together in 32 seconds. Care must be taken not to prolong the heating after fusion is complete; if the heating is prolonged much after fusion the copper is suddenly converted into minute spheres, which scatter themselves about and leave a thin place where the joint should be. My first joints were made long before oxygen could be bought at its present price; with oxygen as now supplied, joints can be easily and cheaply made in big wires and leads; no flux was used in making any of the joints, nor were the ends cleaned previous to their being heated.

Frederick J. Smith.
Millard Lecturer, Mech. and Phy.

Oxford, *November 1st*, 1889.

[Doubtless our correspondent's experiences will be of service to the electrical trades.—EDS. ELEC. REV.]

American Correspondence.

It is eminently just that I should make an apology and an explanation in reply to the letter of Mr. McAdie, and it is equally just that I should protest against your protest against what you rashly term "*want of care*" on my part, in the REVIEW of 11th October.

As to the correctness of the statements which Mr. McAdie is pleased to qualify as "*most distorted, one-sided and untrue*," I should not be censured for having copied *verbatim* the official stenographic report of the testimony of Mr. McAdie given under oath before a legal referee, which was published in nearly all the leading newspapers of New York City, and, so far as I know, has not been contradicted by any publication of Mr. McAdie.

Upon enquiry, I find that I mistook this witness for another electrician of the same name, a resident of New York city, who, I know personally, is in the employment of the American Bell Telephone Company as a detective; I therefore tender to Mr. McAdie an apology for the mistake.

Das Telephon.

Baltimore, *October 25th*, 1889.

Trades Union.

The time seems to have arrived when the workmen in the electrical industries have made up their minds to constitute a "union" among themselves.

There is no doubt much to be said, both for and against trades unions, as a careful perusal of the accounts of the recent dock strikes show.

My main reason for writing is to show one great point which I think must have passed unnoticed by those present at the meeting, viz., the uselessness of attempted secrecy; I think it a great pity that they did not let their names be made public if only as a guarantee of good faith. One thing must be taken into consideration, namely, that to have a union which is to help the *employé it must* be one to help the employer, and so surely as the men make a secrecy of it, so surely will the masters have just cause to think that rules have been made that are detrimental to their interests. I think most of us will remember the so-called union which was started some years ago. I think that the failure of it was due to the fact that rules were made so adverse to the just interests of the masters that they could not possibly acknowledge such a union, hence its failure; had the rules been made fair on both sides many men would have now been in much better circumstances.

I can see no reason why men need fear their names being mentioned, as I am sure the employers and their engineers would be glad to see such combination and quickly avail themselves of its advantages; for instance, what can be more annoying to a master than to pay a man's fare 100 miles or so on his representing himself as a wireman to find when he starts work that his only title to that name lies in his having been employed "wiring aerated water bottles."

In conclusion, I would advise them once more to make their names and resolutions known, and thus gain what I am convinced will be their greatest support, their employers good wishes and assistance.

Wallace Jh. Sandy.

November 4th, 1889.

"Energy" and "Electricity."

Why *will* your correspondents (amongst others) refer to "electricity" as "a form of energy?" In our present stage of knowledge it is by no means safe to make any statement as to what electricity *is;* but we may in many cases be quite "cocksure" as to what electricity *is not.* We know positively, for instance, that it is not a vegetable product, or an allotropic form of CO_2. With still greater certainty we may predicate of electricity—adopting *any* hitherto given definition of the *word*—that it is not, that it cannot possibly be, a "mode of energy." This statement means, simply, that one factor of a product cannot generally equal the product.

Desmond G. FitzGerald.

Overhead Wire Rules.

The following is an extract from a letter from Major Cardew:—"I see there is a mistake in the report of the Chamber of Commerce. 'Low pressure' has not been altered to 600 volts; but when the total potential difference cannot exceed 600 volts, and where the circuit can be earthed in the middle, and where the potential difference between any wires on the same poles or supports cannot exceed 300 volts, the wires are 'low pressure.' Instances:—A 5-wire battery system, 110 between each pair of wires; or a 10-arc circuit with a return wire led back by a different route."

Alexander P. Trotter,
Correspondent of the Section.

Long Distance Lighting.

In your last number you challenged comparison w a certain long distance incandescent system, a desired any of your readers to bring forward anyth to compare with this in flexibility. Perhaps the fo lowing, therefore, may be of interest, and show that lighting has still a chance.

At Quebec, Canada, there were (12/11/88) in use 8 Thomson-Houston arc lights besides series incandes lamps on their well-known system (taking the sa current as the arc lights) and groups of incandes lamps running from their special distributor box, whi divides the arc current up into six circuits for runni 16 C.P. lamps, and interposes automatically a resista equal to any lamp, should one break, but if by accident or design all should be broken, the box is automatically short circuited.

All these lights are run from a lumber mill a Montmorenci Falls, 9 miles away. There are 8 circu each way, and each measures 22 miles, owing to the i direct course the pole line has to take. There are tw exactly similar switchboards at each end of this line, and from that in the town the lighting circuits are distributed.

Several of the circuits have altogether 33–35 miles of line wire in circuit, from which are run promiscously arc or incandescent lamps. The wire between switchboards is bare, but for the lighting circuits underwriters' wire is used.

On the line circuit a river is crossed, an enormous pole 110 feet high being fixed on each bank.

Each circuit and machine is protected by the special Thomson-Houston lightning arrester, and during storms a succession of lightning flashes is always carried safely to earth. They were building a second pole line for motor and alternating service during my visit, which will also be a further interesting exhibit of the flexibility of our Thomson-Houston system.

The long distance series incandescent lighting only is now used in 16—18 towns, and more work has been done on our system in this direction than by all or any other competitors.

An interesting example may be seen at the very neat station of Malden, Mass., where 25 C.P. lamps light streets, &c., all round, some being over four miles distant from machine. My firm is at present engaged in fitting this system for lighting the roads of Weybridge, near London.

This combination of arc and incandescent lighting has tended materially to bring that great success to the Thomson-Houston system which is so well known to all your readers.

Fred. J. Down.

November 5th, 1889.

Five-Wire System.

Your allusion to this novel system compels us to refer to the fact that during the last two years our Thomson-Houston Company have fitted a great number of small towns for general lighting by means of their compensator system, which has an initial tension of 300 volts, and as the distribution transforming compensator is split up into four circuits so as to give 75 volt lamps, it follows that five wires are required.

It is therefore a five-wire alternating system of distribution, and is worked out most perfectly in all details, giving excellent results.

We enclose you a catalogue, a copy of which we sent you a year ago, and on page 45 you will see the arrangement, and also the compound-wound alternating machine for driving it. The latter subject is also a novelty, and has not been previously commented on in this country.

Laing, Wharton & Down, *Managers.*

THE LAING, WHARTON & DOWN CONSTRUCTION
SYNDICATE, LIMITED.

November 5th, 1889.

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WATERPROOF GARMENTS AND FABRICS

[illegible]

GUTTA-PERCHA.

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